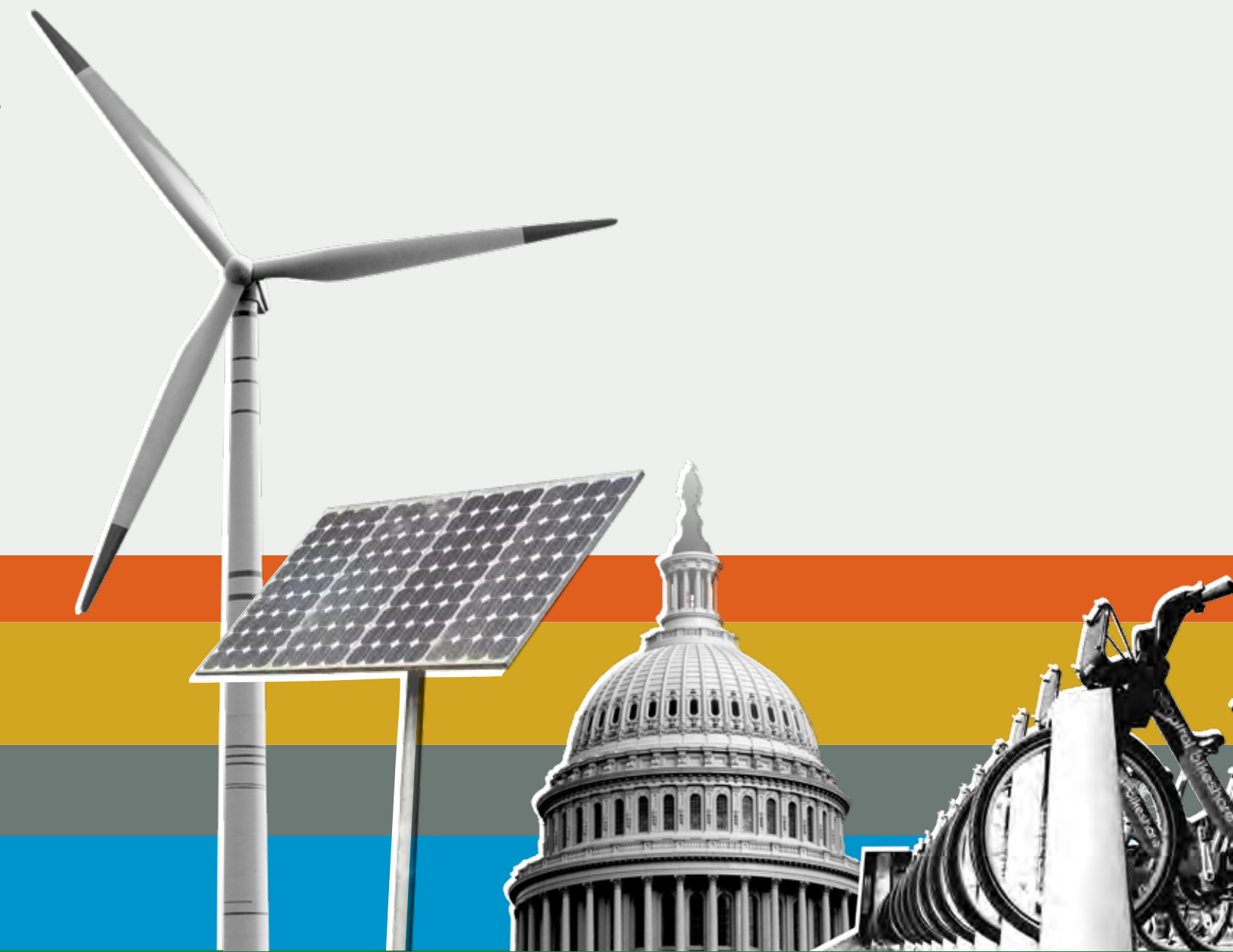




CLEAN ENERGY DC

THE DISTRICT OF COLUMBIA CLIMATE AND ENERGY ACTION PLAN



PRODUCED FOR:



AUGUST 2018

LETTER FROM MAYOR MURIEL BOWSER



Climate change is here. While Washington, DC is already taking steps to prepare for the impacts of climate change, it is critically important that we also reduce our own contribution to the greenhouse gas emissions that cause climate change. In December 2017, in recognition of the importance of local action to achieve the Paris Agreement goal to limit the global average temperature increase to 1.5°C, I pledged to make the District carbon neutral by 2050. We cannot wait to take action if we are to achieve this goal. The Clean Energy DC climate and energy plan laid out here within, is our roadmap to cut greenhouse gas emissions by 50% by 2032 and put us on a path toward carbon neutrality by cutting energy use and increasing the use of renewable energy, as called for by our Sustainable DC plan.

Washington, DC has made great progress on clean energy, which has been recognized nationally and internationally. We have made the largest direct purchase of wind power by an American city government; were recognized as the first LEED Platinum City in the world; and have established strong and innovative programs to save residents and businesses energy and to provide the benefits of local solar energy to low-income residents. However, we must do much more to reduce, and ultimately eliminate, our greenhouse gas emissions while ensuring access to clean energy is equitable and affordable.

The Clean Energy DC plan lays out a thoughtful set of actions that the District Government, local businesses, and residents can take over the next 15 years to dramatically reduce the District's role in climate change. The plan identifies innovative strategies to reduce emissions from buildings, energy supply, and transportation and sets forth roadmaps with timelines to implement these strategies. We developed this plan after listening to ideas from our residents, community stakeholder partners, and leading energy experts. Implementing this plan will require continued input and involvement from residents, businesses, and stakeholders in all eight wards. We must ensure that our plan protects District residents and businesses across the nation's capital while it continues to strengthen the District's and the world's resilience to climate change.

Taking the actions laid out in this Clean Energy DC plan will make Washington, DC more innovative, sustainable, and resilient, and together, we can build a cleaner, stronger, and more equitable future for our city and our global community.

Sincerely,

A handwritten signature in black ink that reads "Muriel Bowser". The signature is fluid and cursive, with a large loop for the letter 'B'.

Muriel Bowser
Mayor

EXECUTIVE SUMMARY

The District of Columbia's Department of Energy and Environment is pleased to provide this climate and energy plan, *Clean Energy DC* (Plan). The Plan articulates a bold and innovative vision to meet the climate challenge, and to create a sustainable, reliable, and affordable energy system that can meet the District's needs far into the future.

WHAT IS THIS PLAN, AND WHY DOES IT MATTER?

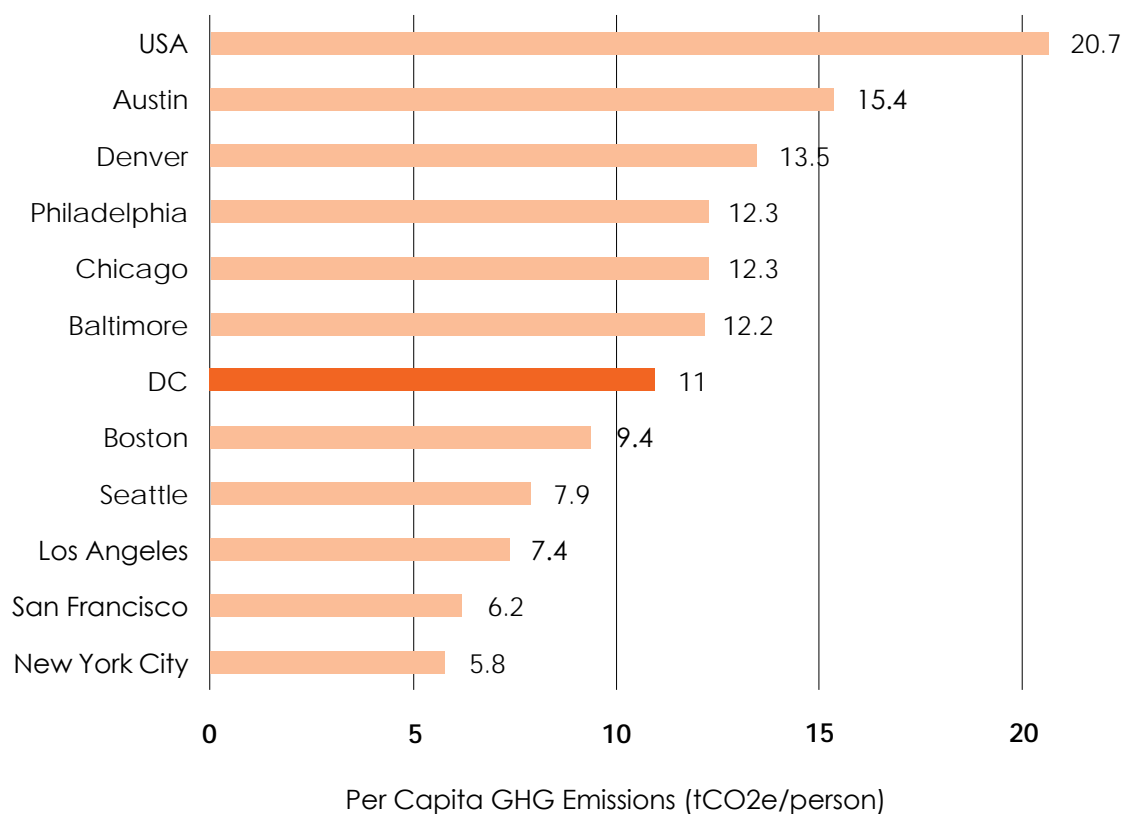
Clean Energy DC is the District's proposal to reduce greenhouse gas (GHG) emissions at least 50% below 2006 levels by 2032 while increasing renewable energy and reducing energy consumption, as directed by the landmark Sustainable DC plan; and to put us on a path to achieve carbon neutrality by 2050, a goal announced by Mayor Bowser in December 2017 in recognition of the importance of local action to achieve the Paris Agreement goal to limit the global average temperature increase to 1.5°C.¹ Sustainable DC Plan's direction to reduce energy use, increase renewable energy, and reduce GHG emissions proposes an important framework for decarbonizing the District's energy system, a framework that focuses on resiliency, efficiency, innovation, and local action. This bold and necessary commitment aligns the District with other global cities that are similarly working to avoid the worst impacts of climate change. (Figure ES 1 summarizes the GHG emissions performance of a sample of U.S. cities.) The carbon neutral commitment also provides a clear long-term vision of a transformed and resilient energy system that reliably, efficiently, affordably, and sustainably meets the needs of the District's residents and businesses. The steps taken to achieve and exceed a 50% reduction in GHG emissions by 2032 will help lay the groundwork for carbon neutrality. By 2020, the District will also develop a plan that builds on *Clean Energy DC* and delivers actions that can achieve carbon neutrality by 2050.

Energy will prove central to the District's efforts to reach its GHG goals. Fossil fuels remain the dominant source of energy for electricity, for heating buildings through natural gas or fuel oils, and for motor vehicles. Over the long term, phasing fossil fuels out of the District's energy supply will be essential to achieving the city's climate commitments.

DOEE's companion climate adaptation plan, *Climate Ready DC*, details the effects of climate change, including higher temperatures more dangerous heatwaves, rising sea levels, and more severe and frequent storms, which residents and businesses are already experiencing. *Climate Ready DC* outlines actions the District will take to adapt to and prepare for such changes. This Plan shows what the District can do to reduce its GHG emissions through bold and innovative energy strategies. If *Climate Ready DC* is the District's defense, then *Clean Energy DC* is its offense. These two documents represent a holistic effort by the Government of the District of Columbia as a leader in energy innovation and in fighting climate change, to ensure that the District remains a desirable place to live and work.

¹ Mayor Bowser Commits to Make Washington, DC Carbon-Neutral and Climate Resilient by 2050", December 4, 2017
<https://mayor.dc.gov/release/mayor-bowser-commits-make-washington-dc-carbon-neutral-and-climate-resilient-2050>

↓ **Figure ES 1:** GHG emissions per capita among leading U.S. cities (in metric tons carbon dioxide equivalent, tCO₂e)



↑ **Figure ES 1:** GHG emissions per capita among leading U.S. cities (in metric tons carbon dioxide equivalent, tCO₂e)²

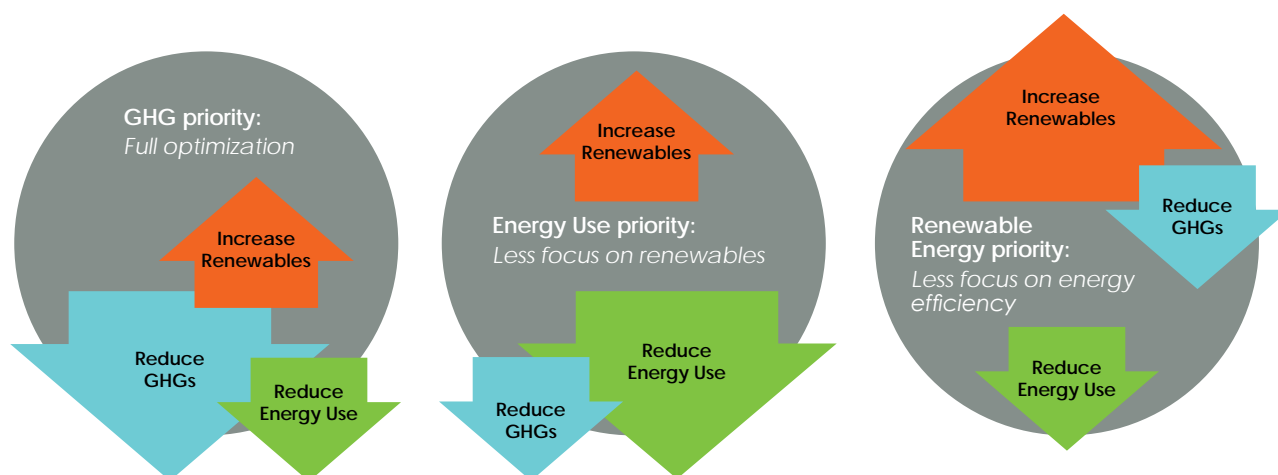
² Source: Carbon Disclosure Project's Citywide Emissions 2016 dataset, <https://data.cdp.net/Cities/2016-Citywide-Emissions-Map/igbu-zjaj>. Note that different cities sometimes use different protocols, so direct, precise comparisons are difficult.

A UNIQUE APPROACH

This Plan is unique: it serves as both a long-term GHG reduction plan and a short-term energy plan. Importantly, it provides a roadmap to achieving the District's 50% GHG emissions reduction target. It identifies major consumption sectors, such as buildings, energy supply, and transportation, and quantifies existing and proposed policies directly affecting GHG emissions in each. These include anticipated building codes, increases in the sourcing of clean electricity, and the District's transportation plan, *moveDC*. This Plan forecasts the impact of each of those policies and details the level of ambition needed to achieve the District's GHG reduction target.

While the actions outlined in this document are sufficient to achieve the GHG reduction target, they are not sufficient to fully achieve *Sustainable DC*'s other 2032 targets: to reduce energy use by 50% relative to 2012 and to increase renewable energy to represent 50% of all energy used in the District.³ During the modeling process, the consultant team concluded that achieving all three targets in unison will prove exceptionally difficult, if not impossible. As a result, DOEE prioritized the GHG reduction target—one of the key *Sustainable DC* targets—and chose actions shown to significantly reduce GHGs while simultaneously reducing energy use and increasing renewable energy.⁴

Prioritizing the GHG reduction target over the other energy targets also makes sense for optimizing efforts and best leveraging limited resources: Reducing GHG emissions through innovative measures necessarily entails both reducing energy use and increasing renewable energy. However, reducing energy use may not result in an increase of renewable energy, and increasing renewable energy may not result in reduction of energy use, as visualized in Figure ES 2.



↑ **Figure ES 2:** Benefits of prioritizing the reduction of GHG emissions

By following the actions in the Plan, the District will reduce energy use 20% below 2012 levels. Further, depending on how electricity suppliers comply with the RPS, 30% of power delivered to the District will originate with renewable sources such as wind and solar. DOEE will build on this work to develop roadmaps to achieve the renewable-energy and energy-use reduction targets, and a path to carbon neutrality by 2050.

³ The coordination and feasibility of these three goals are being addressed in the revision of Sustainable DC 2.0.

⁴ Note that energy use refers to energy consumption.

PURPOSE AND CONTEXT

This is the first District energy plan to explicitly include a GHG reduction target. Although many have been eager to realize the ambitions of *Sustainable DC*'s energy and climate targets, until now the District had not finalized a concrete framework to deliver on them. *Clean Energy DC* offers the analytical framework and measures that are needed to begin this work.

This Plan's actions show how the District can meet its GHG target. While the District can get going on some actions right away, others are more challenging and complex, and will require additional analysis—including detailed technical feasibility work. As there is no one-size-fits-all approach to technical feasibility work, DOEE intends to undertake it while designing *Clean Energy DC*'s implementation.

The District understands that the ultimate success of this Plan hinges in large part on the extent to which it addresses the concerns and priorities of those it will most impact. That's why DOEE has engaged and will continue to engage in robust and inclusive stakeholder consultation. The team is committed to equitable development, and will work with stakeholders in the community to collaboratively shape the Plan's next steps.

This Plan does not identify every action that could potentially reduce GHG emissions; DOEE expects additional strategies will emerge through the collaborative engagement process. The Plan identifies the high-level energy-consuming sectors—buildings, energy supply, and transportation—and recommends actions within those sectors that could lead to significant reductions. The actions list would then allow stakeholders and residents to better understand the scale of ambition needed to achieve the GHG target. The list will serve as a springboard, to allow stakeholders to plan how best to implement each action.

A NECESSARY TRANSFORMATION

The District will not meet its GHG target unless it makes the most of every available policy lever to address buildings, energy supply, and transportation. Taken together, the needed actions amount to nothing short of a total transformation in how energy is bought, consumed, and generated. It will be a significant and sustained effort, and require ongoing support of the public and stakeholders. The District Government must develop a streamlined and robust stakeholder process, to keep up momentum through the Plan's future iterations.

DOEE is proposing *Clean Energy DC* at a time of great change: Fuel prices are volatile, renewable-energy costs are continuing to decline, and innovation is accelerating—as is the rate of climate change. The energy and climate landscape is dynamic. To ensure the Plan remains relevant against this backdrop, DOEE has committed to ensuring it is open and iterative—a flexible and adaptable “living document.”

WHAT DOES THE PLAN PROPOSE?

To recap, the Plan identifies buildings, energy supply, and transportation as the District's major GHG sources. To meet its target, the District will need to significantly reduce GHG emissions in all three.

- Building actions include policies to target both new and existing buildings, plus cross-cutting actions (Chapter 4).
- Energy actions aim to increase the supply of clean and renewable energy and modernize the District's energy system (Chapter 5).
- Transportation actions chiefly seek to transition passenger and transit vehicles from conventional internal-combustion engine cars and buses to electric models that produce zero tailpipe emissions (Chapter 6).

The Plan's core actions for these three sectors represent a pragmatic expansion of existing policies, such as the District's innovative construction codes, the Renewable Portfolio Standard, and *moveDC*, the District Department of Transportation's 25-year vision, which includes actions to increase travel by walking, biking, and public transit.

The consultant team did not calculate the anticipated GHG reductions for every action, but did do so for significant existing and proposed policies in these three sectors. The Plan also includes a number of actions—such as developing electric vehicle charging infrastructure—that aim to support or facilitate core actions, but do not directly reduce GHG emissions.

Each section provides a pathway to achieving the GHG reduction targets for each of the sectors, and identifies a suite of actions to achieve them. As stated earlier, the Plan is not intended to provide detailed program design, specific policy language, or detailed feasibility analysis for each action; DOEE will conduct that work during the consultative stakeholder process that will follow this Plan's release. This Plan does, however, include design and implementation language, details, research, and recommendations gleaned from lessons that other cities have already learned.

The key actions needed to achieve the District's targets are outlined below; a full list of actions can be found at the end of the Executive Summary.

BUILDINGS

NEW CONSTRUCTION

To achieve the 50% GHG emissions reduction target, the District Government must implement a net-zero-energy building code that serves to shift buildings away from reliance on fossil-fuels (e.g., natural gas, coal, oil) for heat and hot water. To successfully implement such a code, the District Government will need to provide incentives, education, and training, and demonstrate leadership by requiring very high performance in its own new buildings. Significantly higher energy performance from buildings under the new code is projected to help the District avoid 4.6% of the GHG emissions that would have been produced in 2032 if no action were taken.

EXISTING BUILDINGS

While net-zero energy codes will reduce fossil fuel use in new buildings, the District must retrofit a significant portion of its existing buildings to increase their efficiency and reduce their fossil-fuel reliance. Retrofits at this scale require well-financed, data-driven, and carefully targeted programs. By retrofitting nearly one in five buildings to achieve an approximate 40% reduction in energy use, and leading by example in its own buildings, the District will avoid 9.5% of the GHG emissions that would have been produced in 2032 if no action were taken. The plan also includes a significant number of supporting actions aimed at increasing energy efficiency in existing buildings and transforming the building sector.



ENERGY SUPPLY SYSTEM

CLEAN AND RENEWABLE ENERGY SUPPLY

To achieve its 50% GHG emissions reduction target, the District must increase its supply of renewable energy, and the renewable portfolio standard (RPS) is a key policy to do so. The District Government should configure its RPS to require a steadily increasing proportion of renewable energy, and promote ways of procuring energy that will yield tangible GHG reductions. In addition to these changes to the RPS, the District should also:

- Replace the current Standard Offer Service (i.e., the supply contracts for customers who do not choose competitive suppliers) with a mix of short-term and long-term contracts, including long-term power purchase agreements that maximize renewable energy.
- Develop neighborhood-scale energy system and solar proliferation strategies.
- Increase adoption and installation of solar panels and other renewable energy technologies.

ENERGY SYSTEM MODERNIZATION

Legacy electricity grids are not always well-suited to deal with a large number of small-scale renewable-energy systems. A modernized system would:

- Support a substantial increase in the quantity of electricity generated within the District.
- Fully capture the economic benefits of new local generation.
- Improve overall reliability and resilience.
- Avoid costly ratepayer investments in substations and feeders by using distributed energy resources (DER) and demand-side management practices.
- Support the development of neighborhood-scale energy systems, including microgrids.

This shift to distributed energy resources will require new regulatory frameworks, market structures, and utility incentives. In the longer term, the energy system will need to support distributed transactions—that is, those between individual customers and the distribution system operator, or even transactions between individual customers.

The Plan includes recommended actions to reconsider the way ratepayer investments are made, and to increase the use of cost-effective DER to reduce peak demand and manage load growth in new or congested neighborhoods. Some of this work is already underway through DOEE's participation and leadership in the Public Service Commission's Formal Case 1130, Modernizing Energy Delivery System for Increased Sustainability, and the recommended actions should be taken in coordination with DOEE's and other stakeholders' efforts in that case.

Additional research as well as regulatory and legislative changes may be required to reduce barriers to DER integration, improve understanding of the District's energy supply and demand, develop cost-effective neighborhood-scale energy systems, and demonstrate the full value of a modernized energy system.

TRANSPORTATION

MODE SHARE CHANGES

To meet its target, the District will need to secure significant transportation-sector GHG reductions. This will involve reducing dependence on private petroleum-powered vehicles (and shifting to public transit, biking, and walking) and by transitioning to zero-emissions vehicles. The District has long encouraged residents to pursue fossil-free travel alternatives, and continues to do so.

The District is also investigating strategies that would reduce emissions from its own fleets. Using the District's existing transportation actions on mode shift found in *moveDC*, the District can avoid 3.6% of the GHG emissions that would otherwise occur in 2032.

Further, the *Clean Energy DC* team finds that existing federal fuel-economy standards will avoid another 7.1% of the GHG emissions projected for 2032. As specific actions regarding *moveDC* and the federal fuel economy standards are beyond the scope of this Plan, the Plan does not specify further recommendations.

ELECTRIC VEHICLE READINESS AND ADOPTION

The District should encourage residents to pursue alternative, low to zero-GHG travel modes, but it should also promote high efficiency hybrid and zero-emission electric vehicles.

As existing District Government plans address other areas of the transportation sector, *Clean Energy DC* zeros in on the opportunities of vehicle electrification. The Plan recommends policies and actions that provide electric vehicle infrastructure, such as public charging stations. It also identifies financial and other appropriate incentives to make it easier for people to choose an electric model when shopping for a new vehicle.

Data indicates that 70% of vehicles are on the road for at least 15 years, and the District Government has few policy tools to encourage an electric car purchase.⁵ However, the District Government can and should work to increase the share of electric vehicles in car-sharing and other private-sector fleets.

The District Government should consider electric vehicle policy as one way to achieve carbon neutrality by 2050. Through actions to increase electric vehicle adoption, the District can avoid 0.9% of the GHG emissions that would otherwise occur in 2032, while laying essential groundwork for carbon neutrality.

5 National Highway Traffic Safety Administration, <http://www-nrd.nhtsa.dot.gov/Pubs/809952.pdf>

ELECTRIFYING TRANSIT BUSES

As more residents choose public transit, the associated energy use and GHG emissions increase. Although transit GHG emissions are considerably smaller than passenger vehicle emissions, if the District is to meet its energy, emissions, and carbon neutrality goals, it will eventually need to decarbonize public transit.

The Plan recommends that the District Department of Transportation (DDOT) and the Washington Metropolitan Area Transit Authority (WMATA) replace their retired diesel buses with electric buses, and choose those models when expanding their fleets. A shift to electric buses over the coming 15 years will avoid 2.6% of the GHG emissions that would otherwise occur in 2032. A shift to electric buses and passenger vehicles will also eliminate a source of street-level air pollution, allowing both citizens and visitors to breathe easier.

FUTURE TRANSPORTATION TRENDS

As of 2017, several automakers are working to develop autonomous vehicle technologies; if successful, residents may at some future point travel around the District without a human at the wheel. Meanwhile, self-driving or not, networked transportation companies are accelerating the trend towards the concept of mobility as a service, and away from traditional private-vehicle ownership.

In the same way that the proliferation of private vehicles and freeways shaped 20th century city planning and individual behaviors, self-driving cars and shared ownership models could dramatically alter the whole transportation experience, opening up new challenges and opportunities for cities.

From a climate and energy perspective, these changes could be positive or negative—depending primarily on how the vehicles in question will be powered. Whatever form this emerging transportation system ultimately assumes, the District must take steps to ensure the vehicles at the center of it produce zero emissions.

AN EFFECTIVE PLAN

Implemented together, the actions recommended in the Plan will result in an estimated reduction in the District's GHG emissions of 56% by 2032 (relative to the 2006 baseline). As success in some areas of the Plan will depend heavily on success in others, the District Government should implement the actions in a coordinated and strategic manner. Table ES 1 below demonstrates how the recommended policies and programs will transform the District's energy system, drive deep and sustained GHG reductions, and continue to position the District as a leader in climate change mitigation and energy innovation. The GHG reduction figures shown in Table ES 1 are relative to projected GHG emissions in 2032 under business-as-usual assumptions. A fuller version of this table, showing the historical GHG decreases and the BAU increases, is found in Chapter 2.

Modeled GHG Reduction Actions	GHGs Reduced from 2032 Business as Usual (tCO ₂ e)	Percent GHGs Reduced from Total 2032 Business as Usual* <i>50% reduction vs. 2006 = 40% reduction vs. 2032</i>
Federal fuel economy standards	626,000	7.1%
New Construction Policies	408,000	4.6%
Existing Building Policies	797,000	9%
District Government Buildings	45,000	0.5%
Renewable Portfolio Standard	841,000**	9.5%**
RPS Local Solar Requirement	164,000	1.9%
PPA for Standard Offer Service	584,000	6.6%
Neighborhood-Scale Energy	49,000	0.6%
Mode Share Change	320,000	3.6%
Electric Vehicle Adoption	76,000	0.9%
Transit Bus Fleet Electrification	230,000***	2.6% ***
Total GHGs Avoided vs. 2032 BAU	4,140,000	47%
Total GHGs Reduced vs. 2006 Baseline	5,870,000	55%

↑ **Table ES 1:** Summary of core GHG reduction actions

Note: All figures based on on-site energy use, and use GHG intensity factors that account for losses from electricity generation, transmission, and distribution, as well as fugitive emissions from natural gas distribution. See section Appendix A1 for more detail.

**Assumes the District captures 57% of the total potential GHG reductions possible under the RPS. See section 2.2.1.2.

*** Savings from transit bus fleet electrification also reflect increased use of busses due to mode share change.

*This column measures the percentage reduction in total GHG emissions from the 2032 level under the Business as Usual scenario.

For example, New Construction actions decrease total District-wide 2032 GHG emissions by 4.6%. Due to GHG declines between 2006 and 2015, as well as projected GHG increases between 2015 and 2032, the District must avoid 40% of projected GHGs in 2032 to decrease GHG emissions 50% relative to 2006 levels.

NEXT STEPS

DOEE will now work with stakeholders and residents to design an inclusive engagement and consultation process. The team will incorporate that feedback into future iterations of the Plan, yielding a living document that will ensure ongoing long-term support.

The District Government will work to ensure that the Plan's actions will support everyone in the District, with an eye towards existing energy equity and affordability challenges. Chapter 3 discusses steps taken through the development of the Plan to make progress on these issues. The task of transforming an energy system and achieving carbon neutrality will be exceptionally complex. The steps forward will not always follow a straight line. But however difficult the work ahead, the District will make equity and affordability central considerations in the process, seeking to support and amplify the voices that have traditionally been excluded from the energy planning process. The *Clean Energy DC* team's engagement and governance approach uses this Plan as a springboard to empower all residents to review and shape the path forward.

As stated previously, this collaborative and iterative process of evaluation, implementation, and revision needs to be institutionalized to sustain the effort over many years. Guidance for how to effectively govern and implement the Plan can be found in section 1.6 of the chapter 1. DOEE intends to formally update and revise the Plan as often as is warranted under this process. DOEE recognizes that the plan will succeed or fail based on the ongoing involvement of stakeholders and residents. A meaningful process, including public education and outreach, is key to achieving success.

A DYNAMIC AND RESPONSIVE PLAN

The Plan must be implemented in a manner that balances bold action and leadership with public receptivity, market conditions, and technology.

The District Government will closely coordinate *Clean Energy DC* actions with existing agendas and plans. Its proposed actions are already aligned with those in several major District Government plans, including *Sustainable DC* (2013), *moveDC* (2014), and *Climate Ready DC* (2016).

The District and other agencies will stay on top of emerging trends and regional, national, and global developments that will inform program design and implementation. These insights and developments will inform the Plan's future iterations.

The Plan should also reflect the innovative work performed under the leadership of the District's Public Service Commission, particularly in Formal Case 1130, the Office of People's Counsel, the Department of Transportation, the Office of Planning, the Department of General Services, as well as the District's water and wastewater utility, DC Water.

The Plan will evolve. Ultimately, it will set the District on a path to achieving its ambitious and necessary climate change mitigation and energy targets, and realize the ultimate goal of making the District the best city in the nation in which to live and work.

CLEAN ENERGY DC

THE PATHWAY TO CUT THE CARBON POLLUTION OF DISTRICT OF COLUMBIA



1 CONFRONTING CLIMATE CHANGE

Climate change poses a growing set of risks and challenges. In the global effort to combat climate change, cities have a critical role to play. This means protecting against climate impacts, decreasing the Greenhouse Gas (GHG) emissions that cause climate change, reducing overall energy consumption, and increasing the use of renewable energy.

HOW WILL THE DISTRICT PLAY A CRITICAL ROLE?

Clean Energy DC is the District's plan to cut

**GHG emissions
in half by 2032**

The District has committed to become

**Carbon Neutral
by 2050**

2 A COMPREHENSIVE ENERGY PLAN

Clean Energy DC is the District's strategic action plan to make the District's energy system more sustainable, resilient, and equitable.

THE DISTRICT'S TARGETS FOR 2032

50%

Reduction
in annual
GHG emissions



50%

Reduction
in energy
consumption



50%

Of all energy
derived from
renewable
sources



Achieving these targets means transforming buildings, energy supply and distribution, and transportation.

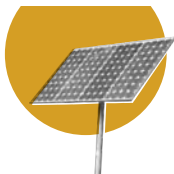
3 PATHWAYS TO CLEAN ENERGY

The District will use three broad strategies to achieve deep GHG reductions:

**EFFICIENT
BUILDING DESIGN
& OPERATIONS**



**MODERNIZED &
RENEWABLE ENERGY
SUPPLY**



**ELECTRIFICATION
& FUEL SWITCHING**



4 TARGETED ACTION AREAS

CONSTRUCTING NET-ZERO BUILDINGS

Require highly efficient and zero emission new buildings

RAMPING UP RETROFITS

Expand and intensify energy use reductions in existing buildings

SHIFTING TO CLEAN ENERGY

Move from fossil fuels to clean and renewable energy

GROWING LOCAL SOLAR

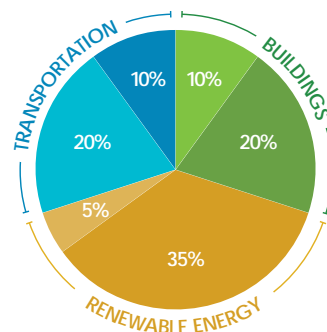
Maximize local renewable energy generation

ELECTRIFYING TRANSPORTATION

Electrify bus transit, vehicle sharing, and personal vehicles

SHIFTING TRANSPORTATION

Increase the use of walking, biking, and mass transit



INCREASING EQUITY AND CAPACITY

Equip people and organizations with the tools, knowledge, support, and partnership they need

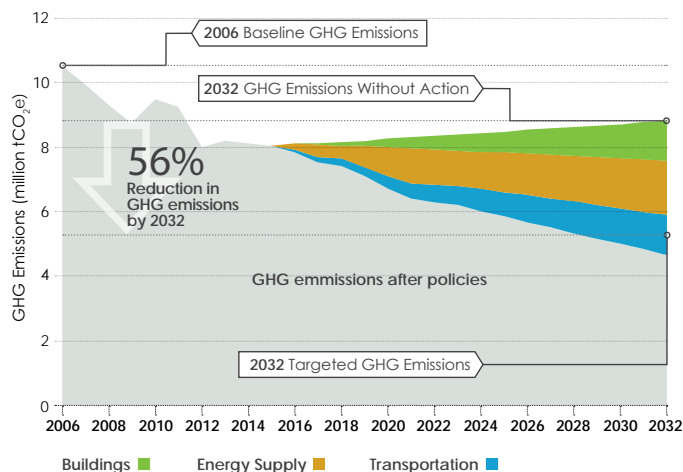
FUNDING THE TRANSFORMATION

Increase funding and financing to eliminate barriers

5 PROJECTED RESULTS

Clean Energy DC aims to avoid projected carbon emissions in order to exceed the District's GHG reduction target.

ESTIMATED GHG SAVINGS



"Taking the actions in Clean Energy DC make the District more innovative, sustainable, and resilient. Together, we can build a cleaner, stronger, and more equitable future for our city."

Mayor Muriel Bowser

Learn more and get involved at CleanEnergyDC.org



COMPLETE LIST OF RECOMMENDATIONS

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Policy and Program Recommendations

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CLEAN AND RENEWABLE ENERGY SUPPLY

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	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	
EQUITY																	
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- Planning, Research, and Program and Policy Development
- Plan or Program Implementation
- Policy or Regulation Implementation

- Pilot Project
- Program Evaluation

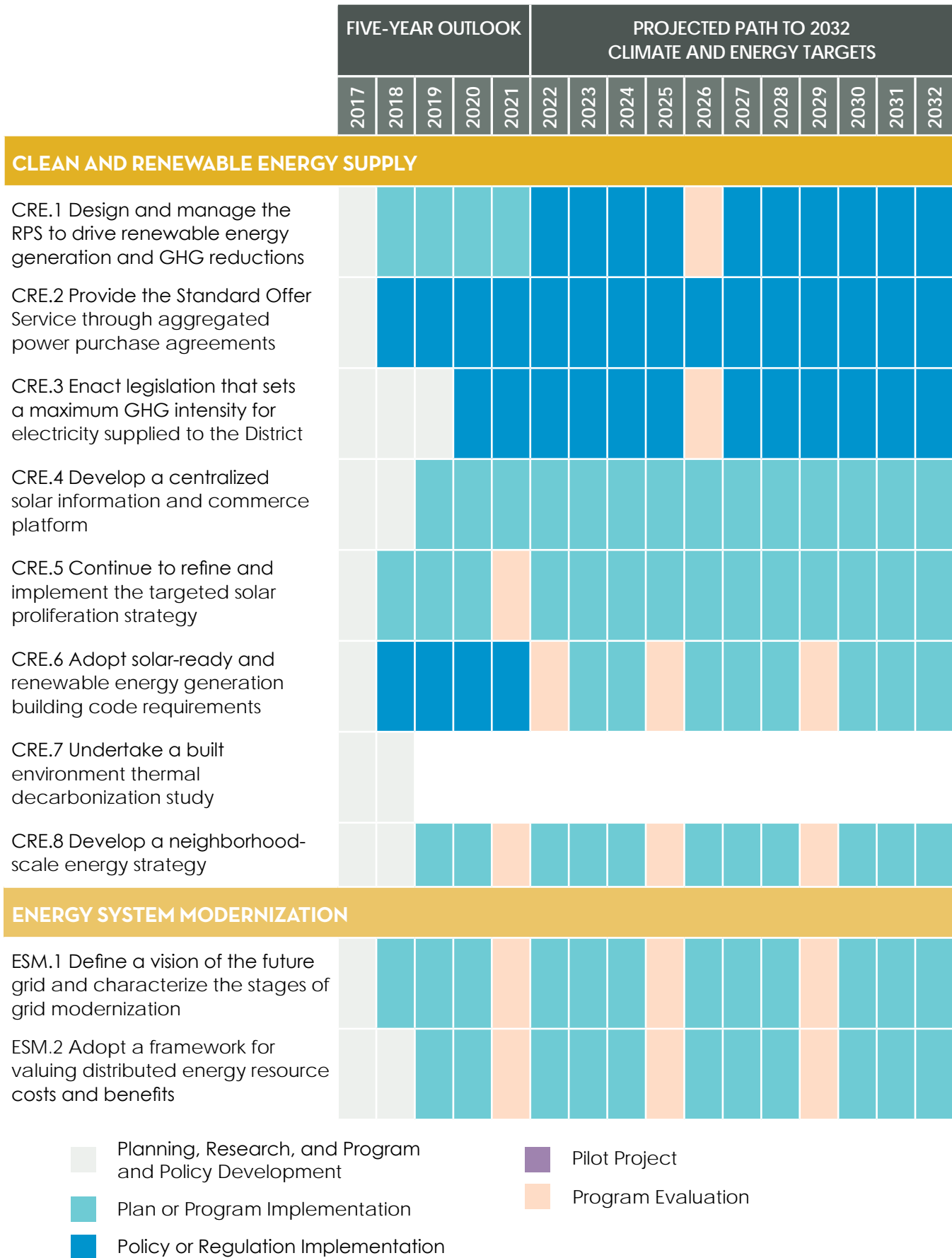
	FIVE-YEAR OUTLOOK					PROJECTED PATH TO 2032 CLIMATE AND ENERGY TARGETS										
	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
EXISTING BUILDINGS																
EB.7 Encourage the adoption of green leases through education and training																
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CCB.4 Incentivize and require submetering																
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	Planning, Research, and Program and Policy Development		Pilot Project
	Plan or Program Implementation		Program Evaluation
	Policy or Regulation Implementation		

	FIVE-YEAR OUTLOOK					PROJECTED PATH TO 2032 CLIMATE AND ENERGY TARGETS										
	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
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CCB.13 Create a coordinated green jobs and workforce development platform																

- Planning, Research, and Program and Policy Development
- Plan or Program Implementation
- Policy or Regulation Implementation

- Pilot Project
- Program Evaluation



	FIVE-YEAR OUTLOOK					PROJECTED PATH TO 2032 CLIMATE AND ENERGY TARGETS										
	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
ENERGY SYSTEM MODERNIZATION																
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ESM.5 Outline a path to overcome legislative and regulatory barriers to grid modernization																
ESM.6 Conduct a hosting capacity study of the District's distribution grid																
ESM.7 Develop a location-based profile of energy use and GHG emissions																
ESM.8 Generate, evaluate, and prioritize a list of actions that the can be taken immediately																
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ESM.11 Pursue pilot projects related to key modernization capabilities and technologies																

	Planning, Research, and Program and Policy Development	Pilot Project
	Plan or Program Implementation	Program Evaluation
	Policy or Regulation Implementation	

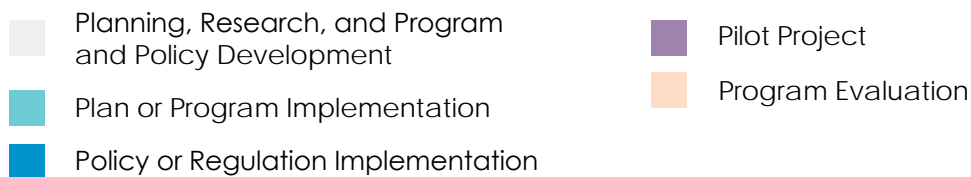
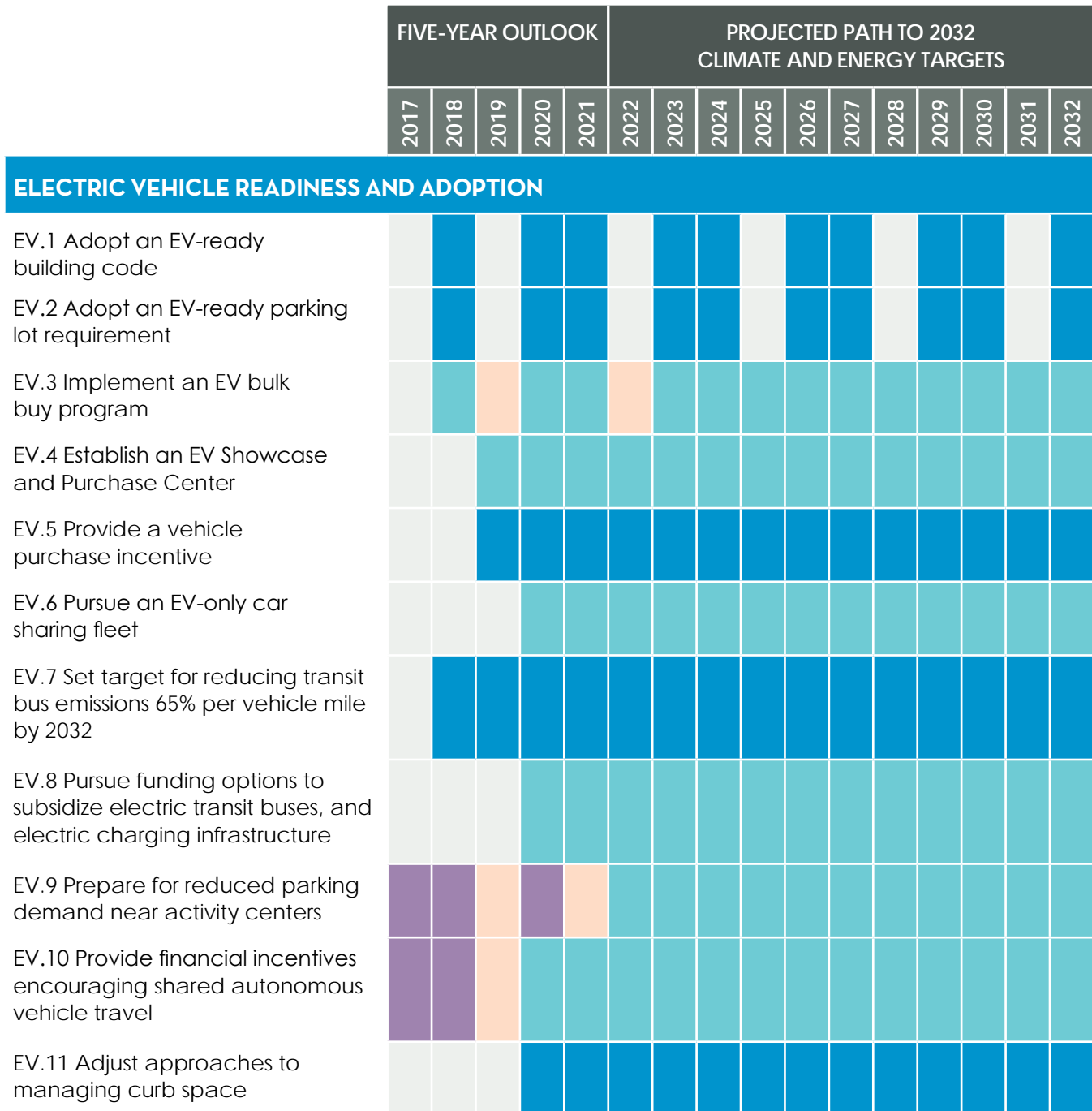


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LIST OF ACRONYMS

ACEEE	American Council for an Energy-Efficient Economy
ACPs	Alternative Compliance Payments
AMI	Advanced Metering Infrastructure
ASHI	American Society of Home Inspectors
ASHP	Air Source Heat Pump
BAU	Business-as-Usual
BEPS	Building Energy Performance Standard
BTU	British Thermal Units
CAEA	Clean and Affordable Energy Act
CAFE	Corporate Average Fuel Economy
CCB	Cross-Cutting Building Actions
CCCB	Construction Codes Coordinating Board
CHP	Combined Heat and Power
CO ₂	Carbon Dioxide
CO ₂ e	Carbon Dioxide Equivalent.
CPP	Clean Power Plan
CRE	Clean and Renewable Energy
CUSP	Centre for Urban Science and Progress
DCHA	District of Columbia Housing Authority
DCHF	District of Columbia Housing Finance Agency
DCPACE	District of Columbia Property Assessed Clean Energy
DCPS	District of Columbia Public Schools
DCRA	Department of Consumer and Regulatory Affairs
DCSEU	District of Columbia Sustainable Energy Utility
DCSUN	District of Columbia Solar United Neighborhoods
DDOT	District Department of Transportation
DER	Distributed Energy Resources
DGS	Department of General Services
DHCD	Department of Housing and Community Development
DMPED	Office of the Deputy Mayor for Planning and Economic Development
DOE	United States Department of Energy
DOEE	Department of Energy Environment
DRAM	Demand Response Auction Mechanism
DSM	Demand-Side Management
EB	Existing Buildings
EM&V	Evaluation, Measurement, and Verification
EPA	United States Environmental Protection Agency
ESM	Electricity System Modernization
EUI	Energy Use Intensity
EV	Electric Vehicle
FAR	Floor Area Ratio
FHA	Federal Housing Administration
GAR	Green Area Ratio
GBAC	Green Building Advisory Council
GCC	Green Construction Code
GHG	Greenhouse Gas
GIS	Geographic Information System

LIST OF ACRONYMS

HUD	United States Department of Housing and Urban Development
HVAC	Heating, Ventilation, and Air Conditioning
ICLEI	International Council for Local Environmental Initiatives
IDP	Integrated Distribution Planning
ILFI	International Living Future Institute
IMT	Institute For Market Transformation
IECC	International Energy Conservation Code
IT	Information Technology
kBtu	Thousand British Thermal Units
KW	Kilowatt
kWh	Kilowatt-Hour
LBC	Living Building Challenge
LEED	Leadership In Energy and Environmental Design
LMI	Low-to-Middle Income
MEDSIS	Modernizing the Energy Delivery System for Increased Sustainability
MDV-SEIA	Maryland, DC, and Virginia Solar Energy Industries Association
MLS	Multiple Listing Service
MMBtu	Million British Thermal Units
MMTherms	Million Therms
MRIS	Metropolitan Regional Information System
MW	Megawatt
MWCOG	Metropolitan Washington Council of Governments
NBI	New Buildings Institute
NC	New Construction
NEEP	Northeast Energy Efficiency Partnerships
NESEA	Northeast Sustainable Energy Association
NZEB	Net-Zero Energy Building
PACE	Property Assessed Clean Energy
PJM	Pennsylvania New Jersey Maryland Interconnection Region
PSC	Public Service Commission
PV	Solar Photovoltaic Power
RCC	Regional Code Collaboration
RECs	Renewable Energy Credits
REDF	Renewable Energy Development Fund
RFA	Request For Application
RFCe	Reliability First Corporation-East
RFP	Request For Proposal
RPS	Renewable Portfolio Standard
SEMP	Strategic Energy Management Plan
SME	Subject Matter Expert
SOS	Standard offer Service
SRECs	Solar Renewable Energy Credits
tCO ₂ e	Metric Tons of Carbon Dioxide Equivalent
UDC	University of District Columbia
VMT	Vehicle Miles Traveled



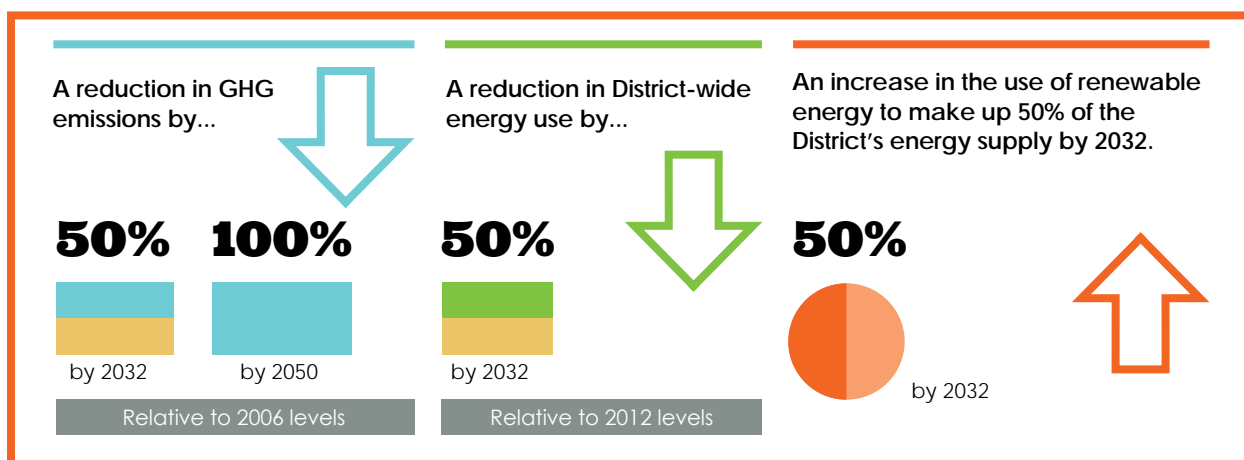
INTRODUCTION

1 INTRODUCTION

The District of Columbia's Department of Energy and Environment is pleased to provide this climate and energy plan, *Clean Energy DC* (the Plan). The Plan articulates a bold and innovative vision to meet the climate challenge, and to create a sustainable, reliable, and affordable energy system that can meet the District's needs far into the future.

The Plan is DOEE's proposal to the District of Columbia to reduce greenhouse gas (GHG) emissions 50% below 2006 levels by 2032, while reducing energy use and increasing the proportion of the District's energy that is supplied from renewable sources, as directed by the District's sustainability plan, *Sustainable DC* (see Box 1)⁶. *Sustainable DC*'s direction to reduce energy use, increase renewable energy, and reduce GHG emissions proposes an important framework for decarbonizing the District's energy system, a framework that focuses on resiliency, efficiency, innovation, and local action.

In December 2017, Mayor Bowser joined other leading global cities in pledging to make the District carbon neutral and climate resilient by 2050^{7,8}. This commitment demonstrates the District's recognition of the growing threat of climate change, the scale of action needed to avoid significant impacts, and the advances in technology, markets, and policy tools that are enabling cities to accelerate action. DOEE developed *Clean Energy DC* to focus on the District's 2032 targets, but the Plan also puts the District on the path to carbon neutrality. The District has begun planning the follow-up work required in 2018 to better understand and develop the path from 2032 to 2050.⁹



↑ Box 1: The District's climate and energy targets

⁶ The District of Columbia, 2013, *Sustainable DC Plan*, <http://www.sustainabledc.org/about/sustainable-dc-plan/>.

⁷ C40 is a network of the world's cities committed to addressing climate change.

⁸ Mayor Bowser Commits to Make Washington, DC Carbon-Neutral and Climate Resilient by 2050, Dec 4, 2017, <https://doee.dc.gov/release/mayor-bowser-commits-make-washington-dc-carbon-neutral-and-climate-resilient-2050>

⁹ See Dec 4 2017 announcement.

While *Climate Ready DC* shows how the District can adapt to such changes, *Clean Energy DC* details the bold and innovative energy strategies that the District can adopt to sharply reduce its GHG emissions. To use a sporting analogy, if *Climate Ready DC* is the District's defense, *Clean Energy DC* is its offense. These two documents represent a holistic effort by the District Government as a leader in energy innovation and in fighting climate change, to ensure that the District maintains itself as a desirable place to live and work.

1.1 FACILITATING A MARKET AND ENERGY SYSTEM TRANSFORMATION

Cities around the world have started to implement a range of plans and strategies to reduce greenhouse gas (GHG) emissions and combat the risks and threats associated with climate change. The District is a leader in this effort, and has already begun to reduce GHG emissions and prepare for climate impacts through its *Sustainable DC*, *moveDC*, and *Climate Ready DC Plans*.¹⁰

Energy will prove central to the District's efforts to reach its GHG reduction goals. Energy, through extraction and consumption of fossil fuels, is the leading global source of GHG emissions. In the District, fossil fuels provide energy for electricity, for building heating and hot water through natural gas or fuel oils, and for motor vehicles. Because GHG emissions associated with fossil fuel combustion can continue to warm the climate for several hundred years after their release,¹¹ phasing out fossil fuels from the District's energy supply (or "decarbonizing" the supply) will be essential to achieving its climate change goals. To successfully mitigate the impacts of climate change, the District must assist in broadly changing the way energy is produced, delivered, and used across the District.

This Plan provides a five-year roadmap that would put the District on a trajectory towards decarbonizing its energy system, and presents a longer-term path towards the District's 2032 targets. The Plan does not provide details on program design or specific policy language for each action, although in several instances it offers design considerations and recommendations. In developing this plan, the team embraced a market transformation approach (**Figure 1**).

To transform the market, the District will work to:

1. Align climate- and energy-related targets.
2. Develop data and information systems to track the District's progress toward its targets.
3. Establish strong regulations for energy production and consumption.
4. Incentivize behavior change.
5. Increase market awareness, consumer demand, and skills development through effective engagement and education programs.

Beyond these actions, the District needs structured and strategic approach to drive long-term decarbonization efforts. The approach must support both the 2032 climate and energy targets and the long-term carbon neutrality commitment.

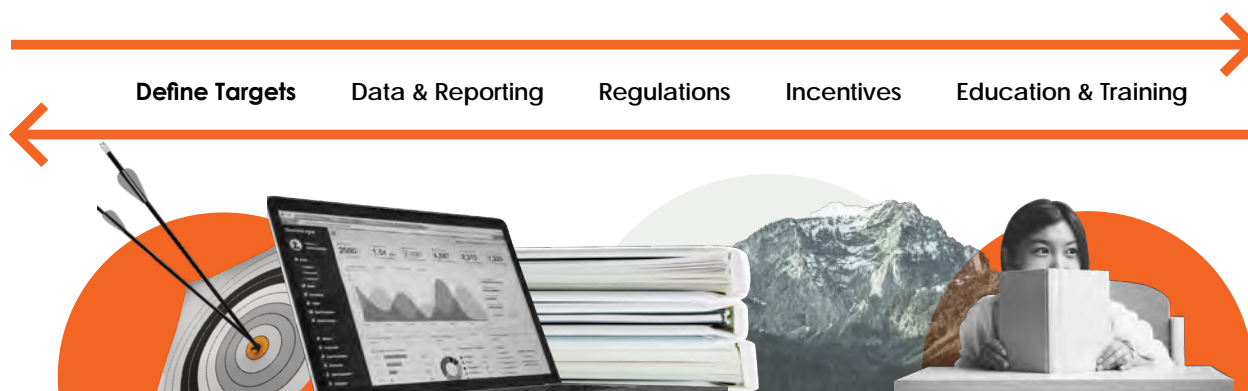
10 District of Columbia, 2012, *Sustainable DC*, <http://sustainable.dc.gov/>;

District of Columbia, 2014, *moveDC*, <http://www.wemovedc.org/>;

District of Columbia, 2016, *Climate Ready DC*, <https://doee.dc.gov/climateready>

11 Hansen J, Kharecha P, Sato M, Masson-Delmotte V, Ackerman F, Beerling DJ, et al. (2013) Assessing 'Dangerous Climate Change': Required Reduction of Carbon Emissions to Protect Young People, Future Generations and Nature. *PLoS ONE* 8(12): e81648. doi:10.1371/journal.pone.0081648

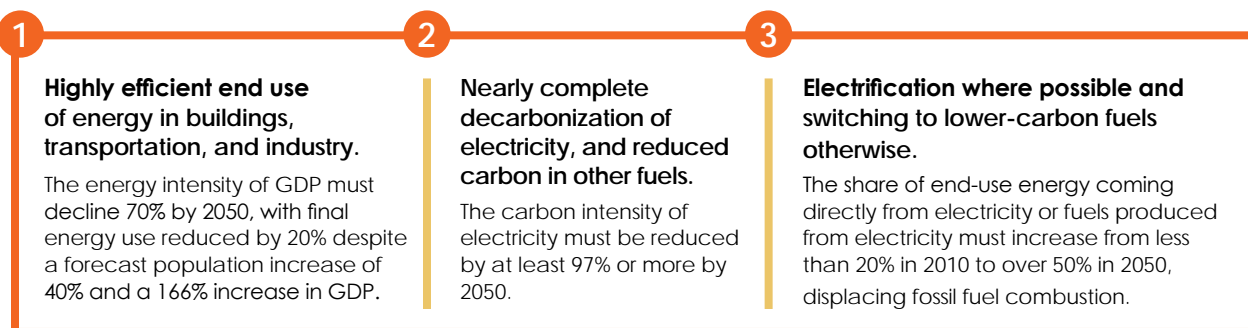
For this, the District must focus on energy system transformation.



↑ **Figure 1:** Components of a Market Transformation

The term energy system here refers to all dimensions of a city's energy use, including all the electricity, natural gas, gasoline, and other fuels consumed by buildings, in transportation, and through energy transmission and distribution itself.¹² If a city is to transform its energy system, it must shift energy generation, distribution, and consumption away from fossil fuels and inefficient, fossil fuel-dependent systems and technologies, and instead embrace highly efficient use of renewable and zero-emission energy. **Figure 2** outlines the energy-system changes needed to eliminate GHG emissions from cities, including the District.

By focusing on a complete energy system transformation, *Clean Energy DC* aims to put the District on the path toward long-term decarbonization, or deep decarbonization. This objective is in line with the work of the Deep Decarbonization Pathways Project (DPPP), a global collaboration of energy researchers sponsored in part by the United Nations.¹³ Deep decarbonization pathways incorporate three imperatives: Increase energy efficiency and conservation, reduce carbon content in electricity and fuels, and switch energy end-uses to low-carbon (and then zero-carbon) energy carriers.¹⁴ (Box 2) This process is already well underway in the District; renewable sources provide an increasing share of the energy used in the district, and GHG intensity is decreasing.



↑ **Box 2:** Box 2 Three pillars of decarbonization with long-term targets for the United States.¹⁵

¹² Note that the term "energy use" is used throughout the Plan to refer to energy consumption.

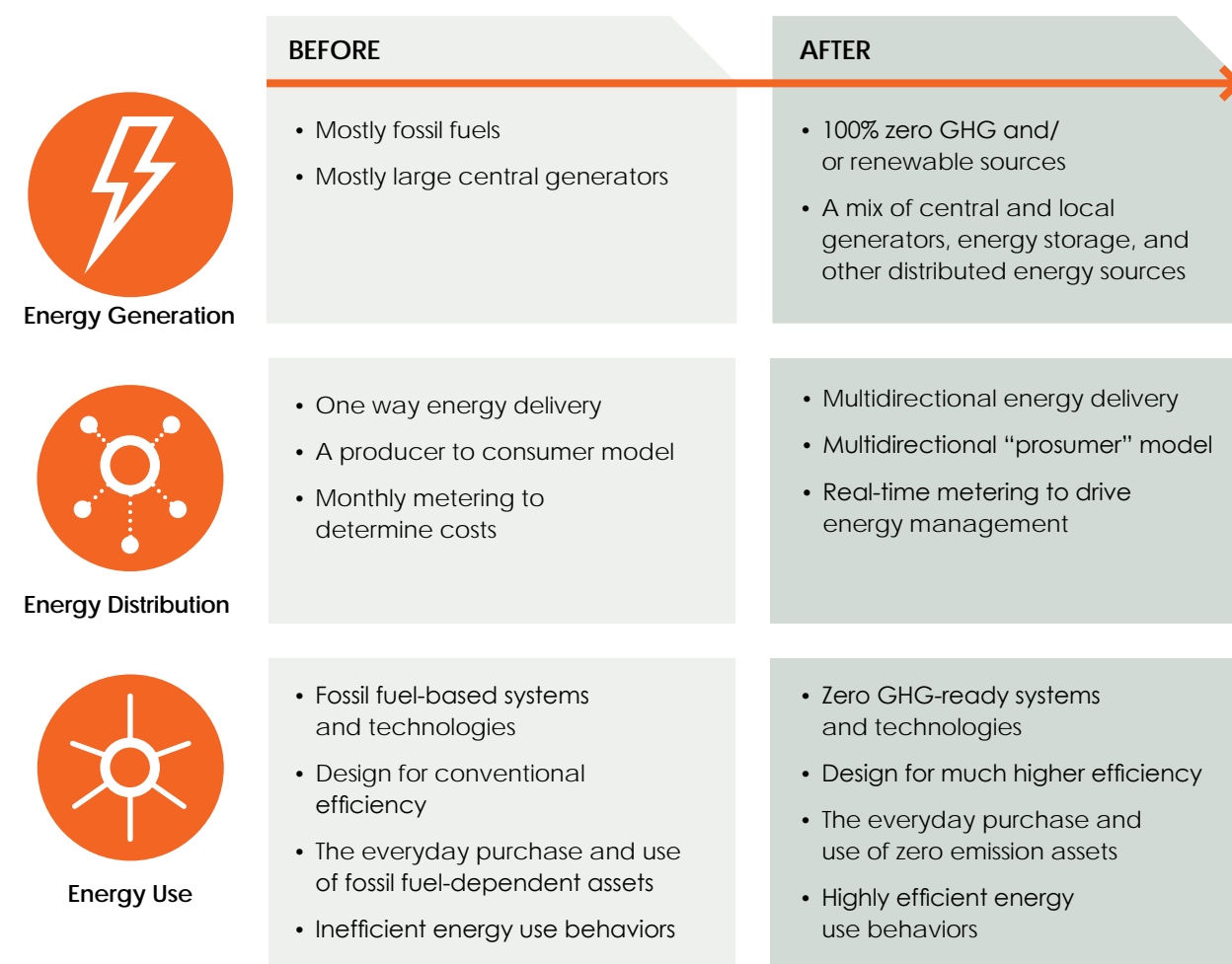
¹³ <http://deepdecarbonization.org/about/>

¹⁴ Williams, J.H., B. Haley, R. Jones (2015). Policy implications of deep decarbonization in the United States. A report of the Deep Decarbonization Pathways Project of the Sustainable Development Solutions Network and the Institute for Sustainable Development and International Relations. Nov 17, 2015.

¹⁵ Williams, J.H., B. Haley, R. Jones (2015). Policy implications of deep decarbonization in the United States. A report of the Deep Decarbonization Pathways Project of the Sustainable Development Solutions Network and the Institute for Sustainable Development and International Relations. Nov 17, 2015.

The three pillars are consistent with the three targets of energy use reduction, GHG emissions reduction, and renewable energy increases, as directed by *Sustainable DC*. The three targets of *Sustainable DC*, in turn, complement each other and lay out an approach to decarbonization that values resiliency, efficiency, innovation, and local action. Energy efficiency will ensure that the District's decarbonization efforts will be "right-sized," and it will empower consumers to focus on their consumption as well as fuel-switching for supply. In terms of renewable energy, by focusing on both the bulk renewable energy and local renewable energy along with energy storage and grid modernization, the District is signaling that it will seek to enhance energy resiliency. The combined effects of these measures will provide a path to the District's goal of carbon neutrality.

Clean Energy DC seeks to achieve the District's existing goals and targets, while enabling and encouraging broader long-term system change. These enabling actions are critical, because energy system change takes time. Buildings can last over a hundred years, while the systems that drive them measure their lives in decades. The average passenger vehicle is on the road for 10 to 15 years. Even behavior change—another key component to decarbonization—takes many years. As such, the Plan not only provides a roadmap of the strategies and actions to achieve the 2032 targets, but lays the foundation for the deeper, longer-term change that carbon neutrality requires.



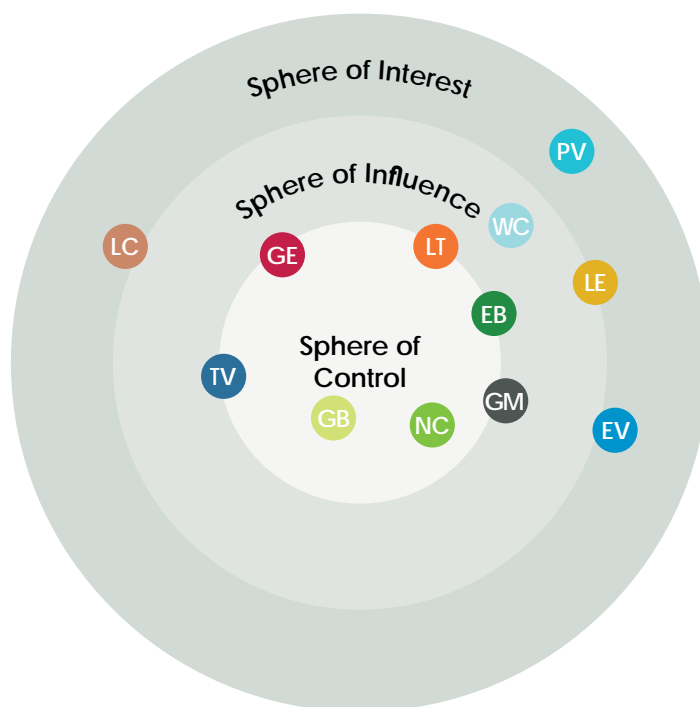
↑ Figure 2: Energy System Transformation Overview.¹⁶

¹⁶ Originally developed for the Carbon Neutral Cities Alliance's *Energy System Transformation Playbook*.

A winning strategy must play to the District's strengths. That's why the Plan team mapped *Clean Energy DC's* proposed actions against the District's sphere of influence. This helped clarify where the District is best suited to affect change, and where it will need to partner. For example, the District is well positioned to improve the energy efficiency of new buildings because it controls its own building code. However, the District Government will have more difficulty accelerating electric-vehicle adoption, because it is more difficult to impact consumer choices, and no auto dealerships are located in the District.

Recognizing the limitations of the District Government's sphere of influence does not mean forgoing or reducing action on important items like electric vehicles. Rather, it helped shape the selection and design of the actions to support successful implementation.

- EB Existing Buildings
- NC New Construction
- GB Government Buildings
- GE Grid Electricity Sources
- LE Local Electricity Supply
- LT Local Thermal Energy
- GM Grid Modernization
- EV Electric Vehicle Adoption
- TV Transit Vehicle Efficiency & Fuel Type
- PV Private Vehicle Efficiency
- WC Walking, Cycling & Transit Use
- LC Lifestyle Choices & Purchase Decisions



SPHERE OF INTEREST: Where the District Government has neither control nor direct influence over components of the urban system, but is interested in, and possibly affected by, the outcome of decisions made by others.

SPHERE OF INFLUENCE: Where the District Government has no decision-making authority, but has access to resources and forums that can be used to influence decision-making by market actors or other levels of Government.

SPHERE OF CONTROL: Where the District Government has near-complete or full decision-making authority over components of the urban system or issue in question.

↑ **Figure 3:** The District Government's sphere of influence over key energy system components.

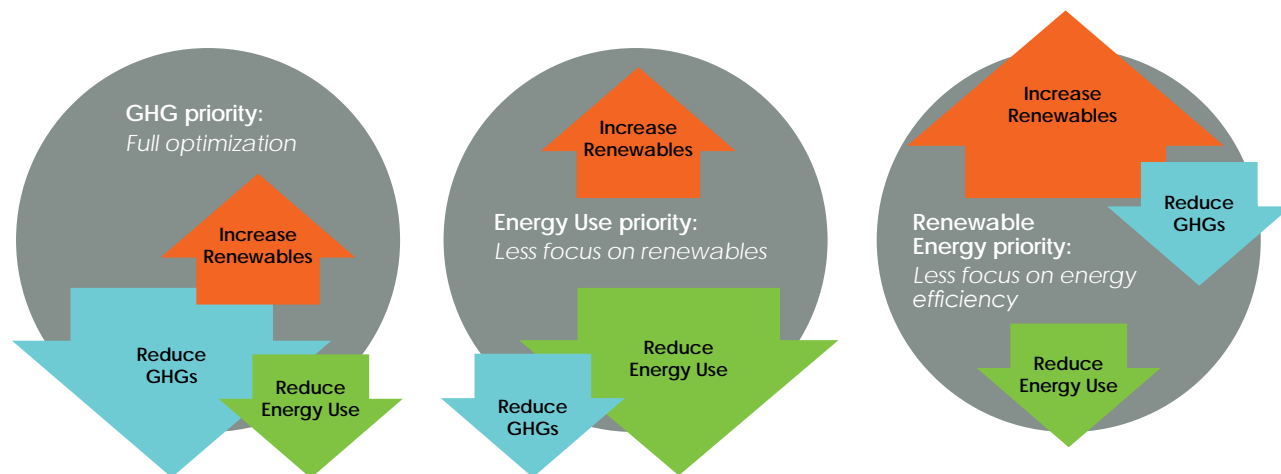
1.2 FOCUS ON GHG REDUCTIONS

While the actions outlined here will allow the District to achieve its GHG reduction target, they are not sufficient to achieve *Sustainable DC*'s goals to reduce energy use 50% below 2012 levels and increase renewable energy 50% by 2032. During the technical analysis undertaken for this Plan, the consultant team concluded that achieving all three goals in unison will prove exceptionally difficult, if not impossible. As a result, DOEE prioritized the GHG reduction target, one of the key *Sustainable DC* energy and climate goals, and chose actions that can significantly reduce GHGs, while reducing energy use and increasing renewable energy.

Prioritizing the GHG reduction target over the other energy goals also makes sense for optimization and synergy: Reducing GHG through innovative measures necessarily will result in both reducing energy use and increasing renewable energy. However, reducing energy use may not result in an increase of renewable energy, and increasing renewable energy may not result in reduction of energy use, as visualized in **Figure 4**.

By prioritizing GHG reductions, the Plan outlines the investments and resources necessary to decarbonize the energy system and mitigate climate change. The energy use and renewable energy targets remain priorities for the District, and the Plan includes actions focused both on energy use reductions and renewable energy increases. The Plan projects that the recommended actions will reduce energy use 20% below 2012 levels, and increase renewable energy utilization (percent of total energy consumption) to approximately 30% by 2032. In subsequent iterations of *Clean Energy DC*, the analytical framework of this Plan will be used to develop the roadmaps for achieving those goals.

The Plan's initial five-year outlook is a brief epoch in the span of an energy system that is rapidly changing. The District Government must continue to engage with key stakeholders to ensure the Plan remains relevant, that it embraces new technologies as they come available, and that it responds to changing fuel prices and market conditions. DOEE team will actively monitor the District's energy system, to ensure policies and programs are taking advantage of new opportunities and overcoming new challenges.



↑ **Figure 4:** Benefits of prioritizing the reduction of GHG emissions.

1.3 HOW BEST TO MOVE FORWARD

This is the first time that a GHG emission reduction target has been explicitly incorporated into a District energy plan. Although many in the District are eager to realize the ambitions of *Sustainable DC*'s energy and climate goals, until now there has been no concrete framework to begin that realization. The Plan offers the analytical framework and specific measures needed to begin this work.

The Plan's recommended actions are ambitious, and their collective impact will be significant. DOEE staff and consultants selected actions by scoring them against the following criteria:

- Scale of action the District needs to take to achieve the District's GHG reduction target (as informed by modeling).
- Efficacy of policies and programs in other jurisdictions.
- Relationship of the actions within the energy-system transformation framework (discussed above).
- Impact upon the fundamental drivers of the District's energy and emissions performance (e.g., building codes, retrofits, electricity supply sources).

If pursued as recommended, this Plan's actions will ensure the District meets its GHG target. While the District can get going on some of the actions right away, others are more challenging and complex, and will require additional analysis—including detailed technical feasibility work. As there is no one-size-fits-all approach to technical feasibility work, DOEE intends to undertake it while designing *Clean Energy DC*'s implementation.

The District Government understands that the ultimate success of this Plan hinges in large part on the extent to which it addresses the concerns and priorities of those it will most impact. That is why DOEE is engaging in robust and inclusive stakeholder consultation. The District Government is committed to equitable development, and will engage with stakeholders in the community to collaboratively shape the Plan's next steps.

This Plan does not identify every action that could potentially reduce GHG emissions; DOEE expects additional strategies will emerge through the collaborative engagement process. The Plan identifies the high-level energy-consuming sectors—buildings, energy supply, and transportation—and recommends actions within those sectors that could lead to significant reductions. The list of actions can be used to convey to help stakeholders and residents to better understand the scale of ambition needed to achieve the GHG target. These actions will serve as a springboard, to allow stakeholders to plan how best to implement each action. There are only so many things the District can do to secure really significant GHG reductions—and many of them will face technical, political, and economic challenges during implementation. To achieve its targets, the District must fully commit to the set of actions presented in this Plan.

While the *Clean Energy DC* team designed the recommendations so that they can be implemented over the next five years, they will influence District Government policy, planning, program design, and decision-making processes long into the future. The team developed each action using a comprehensive process of consultation and engagement that included the following activities:

- An initial engagement session with District Government representatives and stakeholders.
- A review of existing District climate and energy plans, actions, and priorities.

- A review and analysis of District-wide energy and emissions data.
- A collaborative two-day workshop with District Government representatives.
- Ongoing engagement and discussions with District Government representatives and consultants.
- A review of best practices in other leading jurisdictions.
- An engagement period with District stakeholders.
- Revisions based on comments from stakeholders.

To help evaluate the potential impact of different actions and determine an achievable path to achieving the District's GHG reduction target, the consultant team developed a citywide energy and emissions model to simulate different policy scenarios.

The model accounts for all energy and GHG emissions in the District and focuses on representing energy supply, buildings, and transportation (for additional detail on the model, see Chapter 2 and Appendix A1). The consultant team used the model to project future energy and emissions and to quantify the potential impact of various policies and programs.

The consultant team established a baseline of current energy use and GHG emissions to determine principal sources of District emissions by sector and by fuel type, then projected out in a business-as-usual (BAU) scenario through 2032 (further described in Appendix A1). The consultant team then simulated a range of policy scenarios and reviewed the results with District Government representatives.

The consultant team then used these simulations to determine the scale of action needed in the various sectors (e.g., existing buildings, transportation) to reach the District's GHG reduction target. As discussed in Appendix A1, the team did not attempt to quantify all recommended actions because several do not directly reduce energy or emissions, but instead enable the success of other actions. Rather, once the consultant team identified the scale of action needed to achieve the District's GHG target, the team developed a portfolio of energy, buildings, and transportation actions to deliver on them. The consultant team then collaborated with DOEE staff and other District Government agencies to review the modeling results and proposed actions, and ensure that the proposed set of actions are not only strong enough to achieve the District's target, but can also be plausibly implemented.

The model is not intended to be a predictive tool and does not account for costs or externalities other than GHG emissions. The Plan provides this roadmap through a package of policy and program recommendations that have been reviewed by District Government representatives and critiqued by stakeholders.

1.4 INFORMED BY PUBLIC AND STAKEHOLDER ENGAGEMENT

The District Government is committed to a vision of a sustainable city that benefits all—a commitment that extends to climate action. To achieve the GHG goals, the District Government will need to listen to and consider the perspectives, opinions, concerns, experiences of all those who live and work within its boundaries. Given the scale of action this Plan proposes, and its broad and long-term implications, engaging community members and key local stakeholders proved crucial. Beyond this, the *Clean Energy DC* team consulted with local and national equity experts and advocates, to ensure its recommendations would not have unintended impacts on communities. The process of public engagement is summarized below, and is discussed in greater detail in Appendix A2.

The team began stakeholder engagement work with a preliminary visioning session in October 2015, followed by interactive workshops delivered the following March. The initial draft of the Plan underwent an extensive peer review process in September 2016. Seventy-nine people, representing 39 different organizations, participated. This resulted in 178 written and oral comments, which were again incorporated into the draft. It was again edited before its publishing date of October 2016.

In spring 2017, the *Clean Energy DC* team kicked off a fuller public engagement process with residents and stakeholders, to ensure that the Plan represented and supported as broad a range of voices and communities as possible. The team designed engagement opportunities to gather feedback on each of the Plan's key components, and refine its recommendations.

Robust engagement allowed us to verify that the Plan will be relevant and applicable to the specific concerns and issues for communities in all life phases and at all socioeconomic levels, cultures, and ethnicities. As a further benefit, the *Clean Energy DC* team hopes the public engagement efforts also helped broaden and diversify the members of the District's community that see the Plan as something relevant to them.

DOEE hosted events at locations across the District, in all eight wards—from supermarkets to Metrorail stations to community events. During these events, members of the Clean Energy DC team distributed hundreds of leaflets with key information about the draft Plan, and conducted more than 300 surveys to gauge awareness, attitudes, and behaviors on climate and energy. At the same time, DOEE contracted for a statistically significant survey of over 800 District residents across all eight wards, which contained several key energy-related questions to help the District understand the views of citizens on energy efficiency and renewable energy.

In the fall of 2017, the *Clean Energy DC* team also hosted three highly interactive community forums to discuss the draft in greater depth. They engaged community members on climate and energy topics with a goal of gathering input on major concerns, and day to day challenges relating to climate change and energy use. Discussions ranged from financing options for building energy efficiency retrofits for low-income residents, to concerns about ensuring transit accessibility for those who lack a smart phone or credit card. The citywide meetings were designed to engage a wide array of community members, ranging from well-informed climate activists to individuals with no prior knowledge of the District's sustainability efforts. Energy-Palooza, the first community meeting, was a family-friendly event with hands-on activities for attendees of all ages, and was held at the Greater Washington Urban League. The second community meeting, the Clean Energy Power Hour, was held in Navy Yard's Blue Jacket Brewery, and the third, Clean Energy Brown Bag, was held at DOEE's offices; both involved larger presentations and small group discussions. In total, approximately 100 people participated in these three events.

Alongside the public engagement, DOEE hosted specific stakeholder meetings with a wide range of stakeholder groups. Comments from the public engagement, public meetings, and stakeholder meetings all went into the revision and finalization of the Plan. All told, DOEE received hundreds of comments on 114 topically distinct issues. A summary of each comment, with a response from DOEE detailing how the comment was addressed in the Plan, is included in a separate supplement, published on DOEE's website.

To further address how the plan impacted social equity, the *Clean Energy DC* team coordinated a series of stakeholder interviews that focused on the intersection of energy, environment, and social equity. The team invited local and national experts, leaders, and organizations focused on local and national sustainability, social justice, policy advocacy, and community development issues to review and critique the draft Plan's recommended actions. Their recommendations collaboratively develop specific adjustments to the actions and to finalize the Plan. Chapter 3 provides further details on energy and equity, details how each action was changed to better address equity (Table 4. **Amendments to Actions**), and includes a new action that is targeted to address some of the challenges that came up through engagement.

In the fall of 2017, DOEE also launched the process for developing the second version of the overarching *Sustainable DC* plan, *Sustainable DC 2.0*. Feedback from the Climate, Energy, and Built Environment Working Group for *Sustainable DC* was also incorporated in drafting the revision of *Clean Energy DC*.



1.5 A SET OF RECOMMENDATIONS

Many of the recommended actions require further costing, feasibility, prioritization, and implementation work. Some of this work is underway (see section 1.8), and the DOEE team will conduct the rest in coordination with District stakeholders. The resulting set of recommended actions, having undergone this process of intensive public and stakeholder review, is broken into the major components of the District's energy system:

1. **Buildings** actions to target both new construction and retrofits of existing buildings, plus cross-cutting actions (Chapter 3).
2. **Energy Supply** actions to increase the supply of clean and renewable energy, and modernize the District's energy system (Chapter 5).
3. **Transportation** actions chiefly to transition passenger and transit vehicles from conventional petroleum drivetrains to zero-emission electric drivetrains (Chapter 6).

Each corresponding section of the Plan outlines the current status of that particular component and presents a selection of recommendations that draw on existing District Government policy and programming. Recommendations are cross-referenced between sections as appropriate (e.g., where clean and renewable energy actions may depend on energy system modernization actions). The Plan uses the acronyms below, along with an action number, to designate recommendations from the different sections:

- **EQ** – Equity
- **NC** – New Construction (e.g., NC.1, NC.2).
- **EB** – Existing Buildings.
- **CCB** – Cross-Cutting Building Actions.
- **CRE** – Clean and Renewable Energy.
- **ESM** – Energy System Modernization.
- **EV** – Electric Vehicle Readiness and Adoption.

The Clean Energy DC team designed the Plan's recommended actions to be implemented as a unified package. Certain actions depend on others—such as the gathering of information needed to develop and implement a particular strategy. Still other actions provide co-benefits that unlock multiple achievements, such as the industry capacity building needed to understand new technologies or approaches. The actions provided in the Plan should, therefore, be adopted together to equip the District with the full roster of programs, policies, tools, data, information, and capabilities necessary to achieve the targets. A coordinated and strategic implementation is essential to success.

1.6 IMPLEMENTATION PRINCIPLES AND GUIDELINES

A Plan is only as good as the rules that govern its implementation. In the context of a climate and energy plan, governance must consider:

- Assigning roles and responsibilities, and maintaining accountability;
- Measuring and evaluating impacts at regular intervals, and correcting course as needed;
- Engaging with stakeholders to ensure they remain in the loop.

Specifically, the *Clean Energy DC* team recommends the following:

RESPONSIBILITY AND ACCOUNTABILITY

The District Government should engage key enabling partners and stakeholders to track progress on the Plan's delivery. This group should track implementation, specifically the delivery and management of each component of the action plan. There will be instances where management and delivery might be under the oversight of different individuals or departments, or external parties. In all cases, all parties should understand roles and responsibilities, and each team member held accountable. DOEE should aggregate all actions to a centralized annual progress report.

PROGRAM-WIDE REVIEW

To maximize impact and ensure effectiveness of delivery of the Plan, it is recommended that DOEE staff commit to program-wide reviews at regular intervals throughout plan implementation. The appropriate interval for review of the plan is every three years. A three-year review cycle aligns with implementation periods for the various actions, and allows adequate time to introduce new initiatives, build momentum, and calculate impacts.

For each component of the action plan, the review would assess the following:

- Was the program or policy implemented?
- Was it implemented on time, behind, or ahead of schedule?
- Was the update as predicted? (Where relevant)
- Is the impact of the action being assessed?
- Is the impact on target? Does it align with the energy and emissions model projections?
- Is the cost of implementation within projected budget?
- If the program or policy is below target, consider:
 - Is it adequately resourced?
 - What factors are influencing its low uptake, poor compliance, or low performance?
 - Does it need to be refined, ramped up, or cancelled?
 - Is further research needed?
- Are there external factors that have arisen during the three-year period that present opportunities for increased impact? (e.g., fluctuating costs of fossil fuel energy; increasing cost effectiveness of renewable energy)

STAKEHOLDER ENGAGEMENT

The team engaged with stakeholders to create the Plan, and it should continue to engage with them throughout implementation. The District Government should use existing tools and media to provide regular progress updates as the plan rolls out. Where relevant, it is recommended to actively solicit stakeholder input as a component of the Plan Review Cycle to understand areas of opportunity to improve upon actions or particulars of implementation. Stakeholders may include front line employees, third party delivery agents or partners, or District residents impacted by a specific action. Special attention should be given to engaging with and supporting increased capacity among social and racial justice community organizations to ensure proper consideration of equity issues, as described in Chapter 3.

PRINCIPLES TO GUIDE FUTURE REVISIONS

When the Plan is refined or updated, the *Clean Energy DC* team recommends future implementation teams commit to:

- Support long-term economic and social-equity objectives, as defined by DOEE and working groups of community stakeholders.
- Use market-based, data-driven analysis and decision making
- Identify and test the best available policies, practices, and technologies, and support an openness to new ideas when circumstances change
- Measure and monitor impact over time, and correct course when needed
- Ensuring comprehensive consultation that engages stakeholders, the general public, and subject matter experts
- Develop informative and replicable models that will be shared with others

1.7 FINANCING THE TRANSFORMATION

If the District is to reduce and eventually eliminate its reliance on fossil fuels, it will need reliable and consistent financial structures and funding sources. Specifically, the Plan requires a large, stable, and accessible pool of funds to drive unprecedented levels of private investment in renewable energy and energy efficiency. The *Clean Energy DC* team recommends two potential approaches to funding the District's energy transformation: A green bank and carbon pricing.

Of these two approaches, a Green Bank should be a top priority. The DOEE-commissioned District of Columbia Green Bank Technical Report provides a comprehensive analysis of how a Green Bank could finance renewable energy, energy efficiency, and related infrastructure projects.¹⁷ Action CCB.1 discusses key considerations. Although the team has included this in the Buildings chapter, a DC Green Bank can support action on the Energy Supply System as well.

Carefully designed carbon pricing can offer an additional funding mechanism and can help foster a market transformation by shifting consumer, business, and government decision-making toward low- and zero-emission options. A well-designed carbon price would not only send a strong economic signal to the market to reduce GHG emissions, but it could also generate revenue to fund the transition. As DOEE is currently investigating its feasibility, the *Clean Energy DC* team has not included it as an action in the Plan.

17 Prepared for DOEE by the Coalition for Green Capital, August 3, 2016.

1.8 A LIVING DOCUMENT

Given the long time horizons involved, and the speed of change and innovation underway in energy systems, the *Clean Energy DC* team recommends the District Government think of the Plan as a living document. It should be continually revised to incorporate new insights and information.

Alongside the Plan, the District Government commissioned several other studies to support climate and energy policy and program development. These include studies focused on:

- Designing and implementing a green bank ¹⁸
- Designing and implementing effective deep-green retrofit financing ¹⁹
- The potential role of carbon pricing
- The potential role of neighborhood-scaled energy systems, including microgrids ²⁰
- Improving the performance of single-family and small multifamily buildings ²¹
- Ensuring resilience to, and adapting to the impacts of, climate change ²²

Plan authors reviewed drafts, and completed versions of some of the studies above to align recommendations and avoid potential duplication. The team has already incorporated results from the deep green retrofit financing study and the work on single-family and small multifamily buildings. The District should take into consideration the specifics of these parallel studies to develop a complete and detailed understanding of the policies, programs, and other actions required to achieve its long-term climate and energy targets.

In addition to the topics covered by the studies listed above, the Plan does not address actions related to reducing GHG emissions from waste, other social and ecological impacts, nor responding to climate change impacts. Climate adaptation-focused actions can be found in the *Climate Ready DC Plan*, and waste will be addressed as part of *Zero Waste DC*.

¹⁸ *District of Columbia Green Bank Technical Report*, prepared by the Coalition for Green Capital for DOEE, 2016.

¹⁹ *Greening the District of Columbia: Incentives and Policies to Achieve Deep Green Building Construction and Renovations*, commissioned by DOEE and completed by Capital E, 2016.

²⁰ Urban Ingenuity is leading the consultant team working on this report, and has provided GHG reduction estimates for two sites that have been included in the model used to support the development of the Plan.

²¹ *Green Residential Solutions – Recommendations from the Single Family Small Multifamily Green Building Working Group*, June 2016.

²² *Climate Ready DC Plan*

A stylized illustration of a wind turbine against a solid maroon background. The turbine's blades are dark grey with white outlines, and its nacelle is light grey. Concentric white arcs around the turbine suggest motion. A white rectangular box is positioned in the lower half of the image, containing the title text in maroon.

TRANSFORMING TO A LOW CARBON DISTRICT

2

TRANSFORMING TO A LOW CARBON DISTRICT

2.1 THE DISTRICT'S ENERGY USE AND EMISSIONS PROFILE

To identify the set of essential actions required for the decarbonization of the District's energy system, it is necessary to understand the District's current energy and emissions profile. Since the establishment of the 2006 greenhouse gas (GHG) emissions baseline, accurate energy use and GHG emissions data have been collected and calculated for seven nonconsecutive years: 2006, 2009, 2010, 2011, 2012, 2013, and 2015. While there are gaps in the data, the baselines provide a sufficient understanding of the key sources of energy use and emissions in the District today. The primary sources of energy use and GHG emissions across the District are categorized and explained by sector and fuel type below. These sources indicate key elements that require the District's attention to achieve the GHG reduction targets.

2.1.1 HISTORICAL ENERGY USE

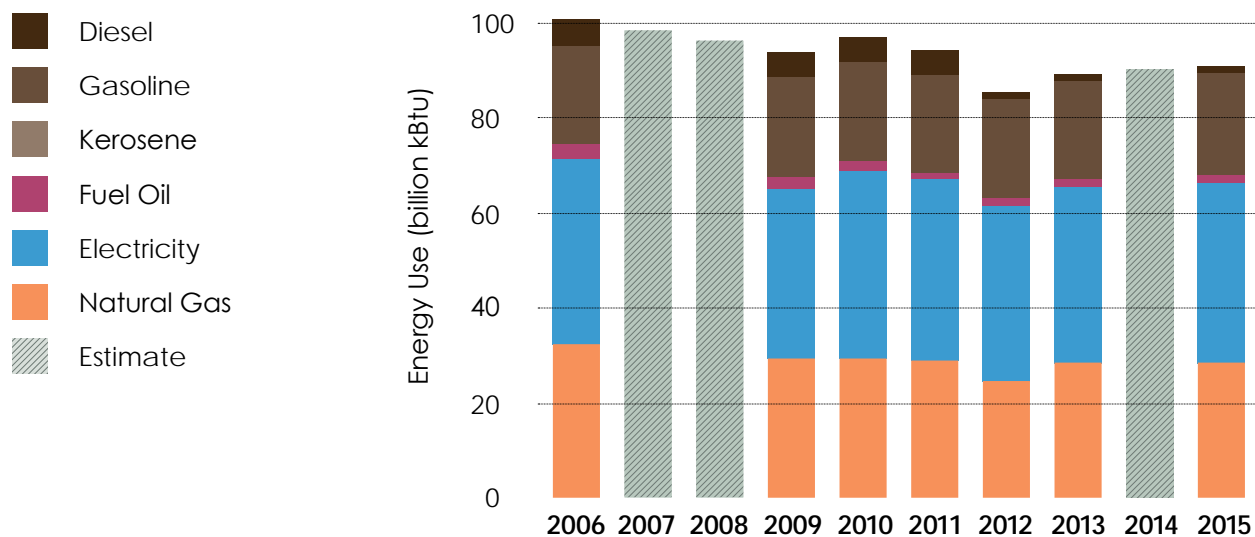
Figure 5 summarizes the trend in energy used in the District between 2006 and 2015, presented by fuel type. All energy consumption reported in the Plan uses site energy based on energy data from DOE. ²³

To align with the District's GHG inventories, GHG emissions reported in the Plan are based on source GHG intensity factors that include losses from electricity generation, transmission, and distribution, as well as fugitive emissions from natural gas pipeline leaks (see Appendix A1 for details).

In 2015, the District used approximately 91 billion kBtu of energy, below the 100 billion kBtu used in 2006, but up from the 85 billion used in 2012. In that year, 96% of energy consumption was concentrated in three sources: electricity (42%) mostly to power buildings, as well as the Metrorail network; natural gas (31%) consumed mostly for building heating; and, gasoline (23%) used primarily for passenger vehicles (**Figure 6**).

While gasoline is sourced from a variety of companies, the majority of electricity and natural gas is supplied to the District by two utilities. Therefore, the electric utility Pepco and the natural gas provider Washington Gas are important stakeholders in a strategy that successfully achieves the District's long-term climate and energy targets.

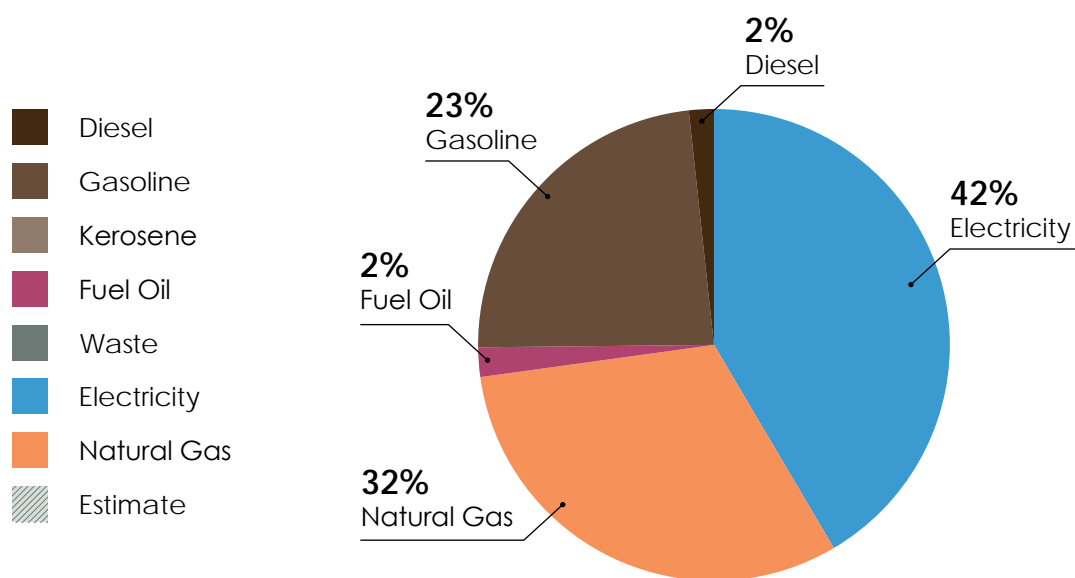
²³ Site energy use is the amount of heat and electricity consumed by a building as reflected in utility bills, whereas source energy accounts for the total amount of raw fuel required to operate a building. Source energy incorporates all transmission, delivery, and production losses. Site energy was used in this plan because it is within the boundary of the District Government, businesses, and residents to control. The impact of generation and distribution on source energy is addressed through the lens of GHG emissions. See a fuller description from EPA at <https://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/use-portfolio-manager/understand-metrics/difference>



↑ **Figure 5:** Site energy use by fuel type, 2006-2015.

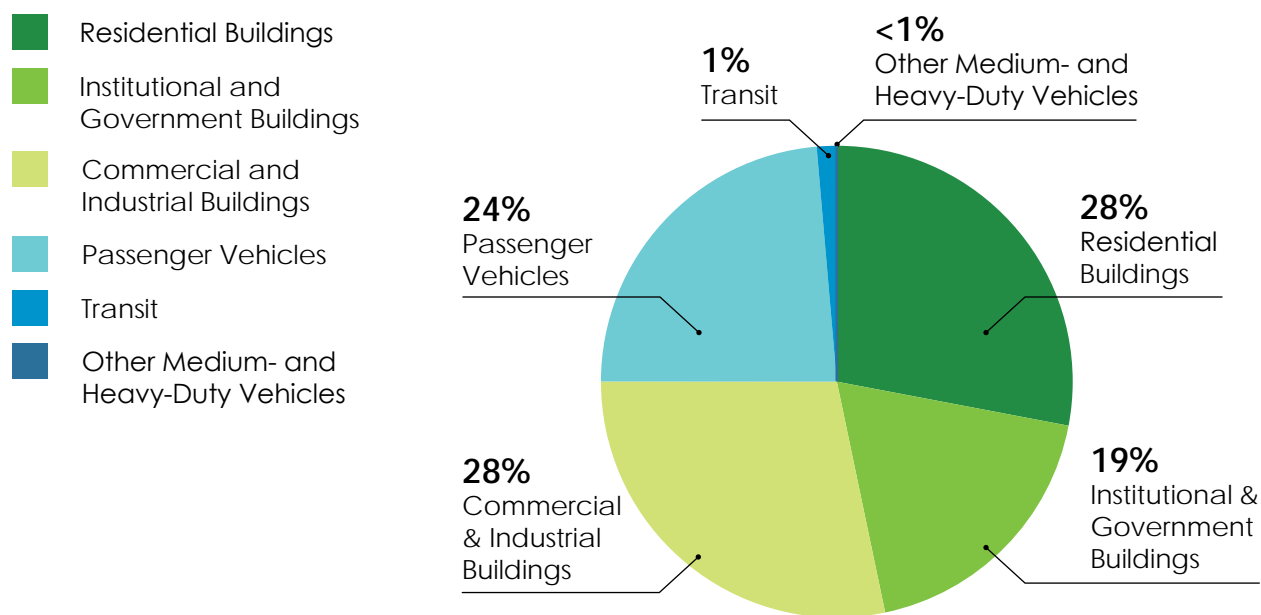
Note: Kerosene use is too small to show up on the graph, but reaches zero by 2012.

Source: District of Columbia Greenhouse Gas Inventory, maintained by DOEE. Data was not available for 2007, 2008, and 2014. This figure uses estimates based on linear annual changes between other years.



↑ **Figure 6:** Proportion of site energy use by fuel type, 2015.

Source: District of Columbia Greenhouse Gas Inventory, summary tables maintained by DOEE.



↑ **Figure 7:** Estimated proportion of site energy use by sector, 2015.

Source: Modeled energy use for the model used to develop this Plan. See Appendix A1 for more details on the model.

Developing the *Clean Energy DC* model allowed the District to more accurately estimate **energy use by subsector** for 2015 (Figure 7).²⁴ It is clear that most energy is consumed by buildings (75%), with approximately equal portions consumed by residential (28%) and commercial and industrial (28%) buildings, with a bit less consumed by institutional and government buildings (18%). The remainder is attributable to transportation (25%), with the vast majority of energy consumed by passenger vehicles (24%), and much lower consumption for transit (1%) and other medium- and heavy-duty vehicles (<1%).

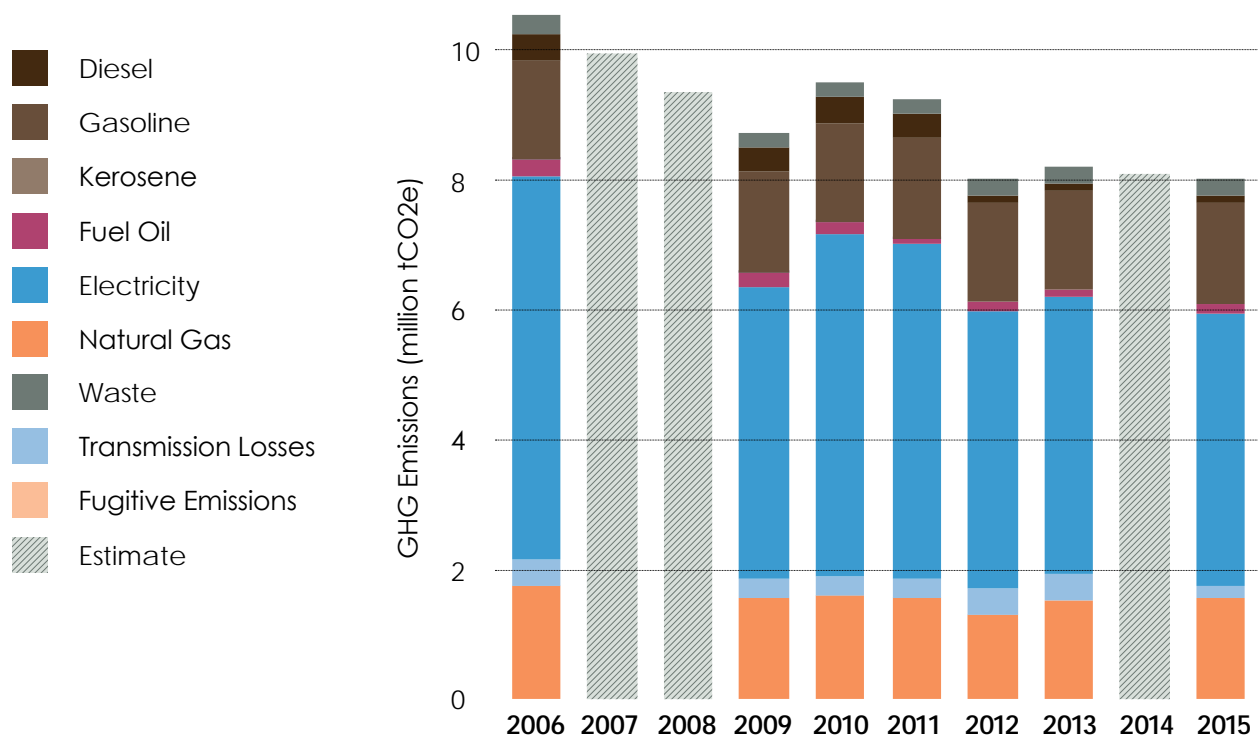
²⁴ Previously, residential and commercial building energy consumption figures were categorized based on electricity rate categories. Because some multifamily residential buildings use commercial electricity rates, the District was not able to separate residential from commercial buildings.

2.1.2 HISTORICAL GHG EMISSIONS

Figure 8 summarize GHG emissions trends by source. In 2015, electricity consumption, almost entirely in buildings, represented 55% of GHG emissions, after factoring in transmission and distribution losses (Figure 9). The District can reduce these emissions by reducing electricity consumption and by shifting to low- and zero-emission electricity sources. Natural gas, the other primary building fuel, accounts for 19% of the District's GHG emissions; these can only be lowered by reducing consumption and meeting building and transportation needs with other, lower carbon fuels.

Transportation fuels emitted comparatively fewer GHG emissions, with gasoline and diesel accounting for approximately 21% of the District's total.²⁵ This imbalance between emissions from buildings and transportation does not indicate the inefficiency of the District's buildings, but rather a transportation sector that generates far lower carbon emissions than the national average. This is in turn the result of a combination of high levels of public transit use and highly walkable and cyclist-friendly neighborhoods.

Solid waste contributes the remaining 3% of the District's emissions. Though this Plan does not address these emissions, the District should continue to target them for GHG reductions. Reducing waste and the resulting emissions is a focus of the District's Zero Waste DC initiative.²⁶



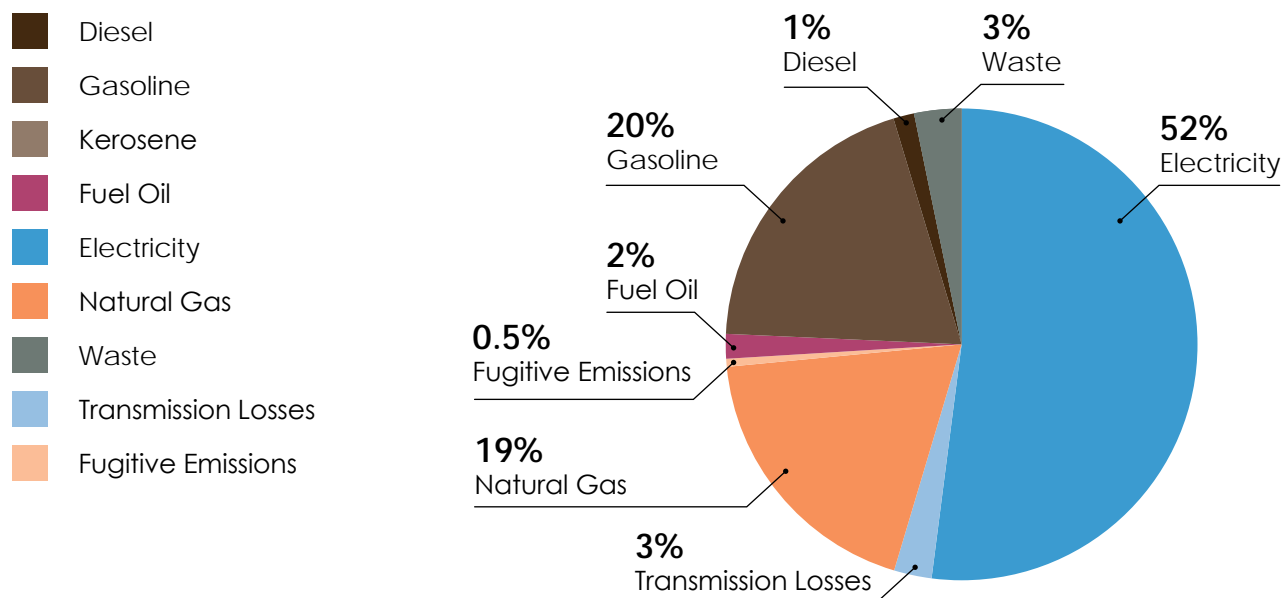
↑ **Figure 8:** GHG emissions by source, 2006 to 2015.

Note: GHG emissions from kerosene are too small to show up on the graph, but reach zero by 2012.

Source: District of Columbia Greenhouse Gas Inventory, summary tables maintained by DOEE. Data was not tracked for 2007, 2008, and 2014. This figure uses estimates based on linear annual changes between other years.

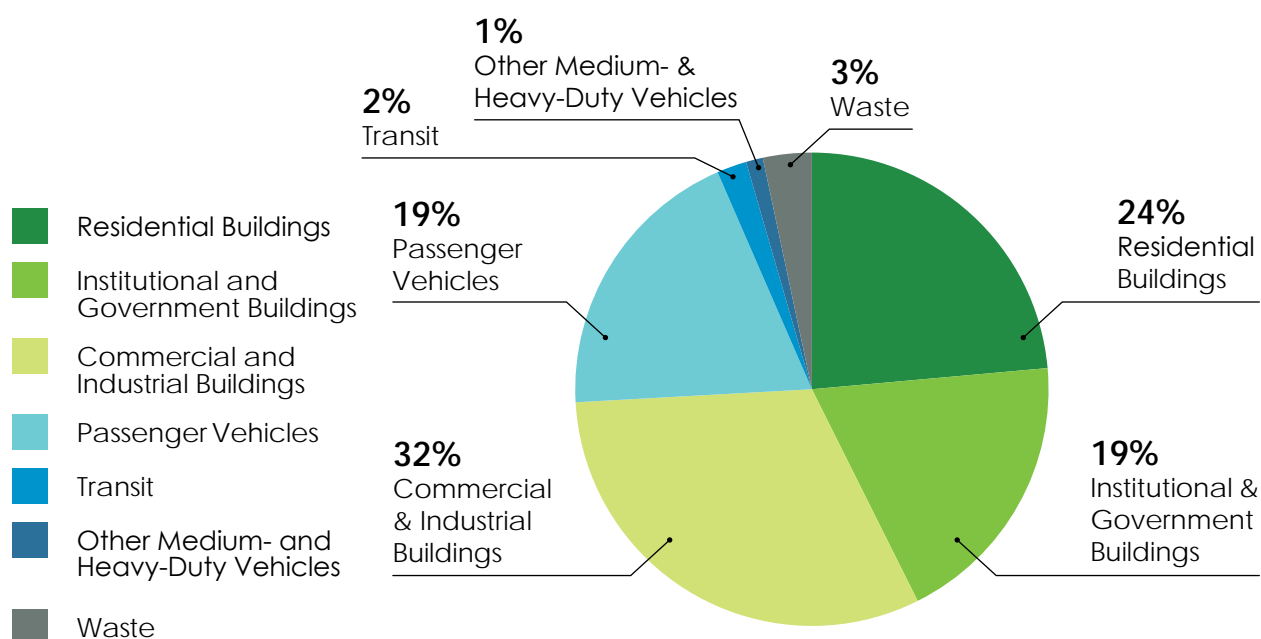
²⁵ Based on all vehicle miles traveled in the District, regardless of origin or destination. Data supplied by the Metropolitan Washington Council of Governments.

²⁶ <https://zerowaste.dc.gov/>



↑ **Figure 9:** Proportion of GHG emissions by source, 2015.

Source: District of Columbia Greenhouse Gas Inventory, summary tables maintained by DOEE.



↑ **Figure 10:** Modeled proportion of GHG emissions by sector, 2015.

Source: Modeled GHG Emissions from the model used to develop this Plan. See Appendix A1 for more details on the model.

The *Clean Energy DC* energy and emissions model also allowed the District to more accurately estimate **GHG emissions by subsector (Figure 10)**.

As with energy, most GHG emissions can be traced to buildings (74%), with most emissions coming from commercial and industrial buildings (31%), followed by residential buildings (23%) then institutional and government buildings (19%), including transmission and distribution losses, and fugitive emissions. The remainder is attributable to transportation (23%) and waste (3%). Within transportation, the vast majority of GHG emissions comes from passenger vehicles (20%), with smaller shares traced to transit (2%) and other medium- and heavy-duty vehicles (1%). To achieve its 2032 GHG target, the District will clearly need to shift away from fossil fuels for buildings (natural gas and fuel oil) and transportation (gasoline and diesel) while simultaneously decarbonizing its electricity supply. For buildings, this will mean shifting to non-fossil fuel sources for heat and hot water. In transportation, the District will need to make transit, walking, and cycling more appealing and cost effective to residents than private vehicles, and transition those vehicles that remain to zero-emission drivetrains.

From 2006 to 2015, the District's total emissions declined 24% between 2006 and 2015. Most of this decline has been attributed to the decreasing GHG intensity of the electric grid, with increases in renewable energy, and as coal power plants are retired and replaced with efficient natural gas plants and renewable energy sources.²⁷ This progressive "cleaning" of the grid is largely beyond the District's control; however, the District's Renewable Portfolio Standard (RPS), in combination with the RPS requirements of neighboring states, has also had some impact. A small portion of the decline can also be attributed to an adjustment in the calculation of diesel consumption, which resulted in a significant decline in the total estimated diesel consumption between 2011 and 2012.²⁸ Meanwhile, GHG emissions from natural gas have remained relatively constant, with annual variations driven by weather and associated temperatures (e.g., colder versus milder winters).

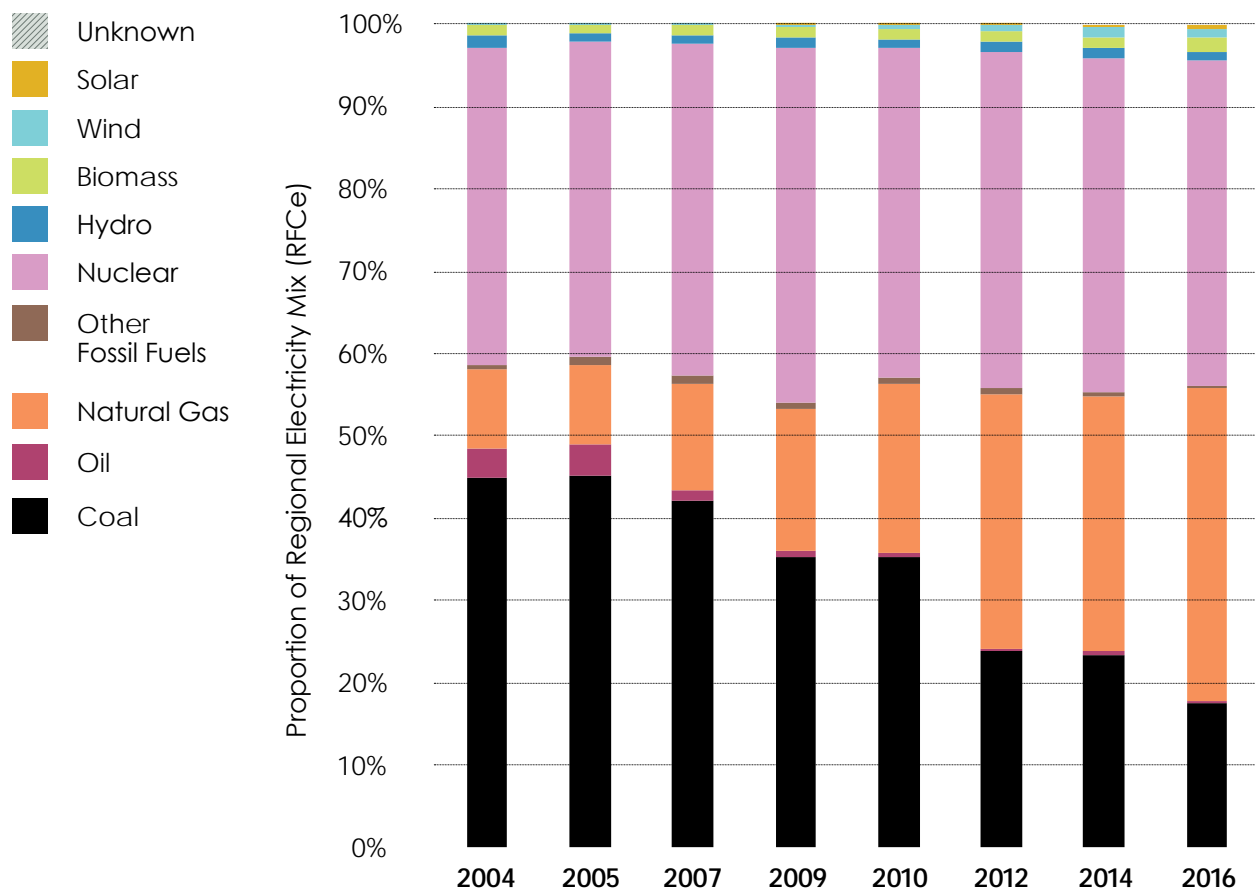
The PJM Interconnection Region (PJM) supplies electricity to the District. While PJM covers a large swath of the country from New Jersey to Chicago, the majority of the electricity consumed in the District originates in Maryland, Delaware, New Jersey, and Pennsylvania. These four states, along with the District of Columbia (which has no substantial power generation), comprise the ReliabilityFirst Corporation-East (RFC-East) sub-region within the United States Environmental Protection Agency's (EPA) Emissions & Generation Resource Integrated Database (eGRID). EPA uses utility data and modeling to determine where most of a region's electricity comes from, and then calculates the GHGs from all power plants in that region.²⁹ This calculation of GHG intensity is what is used by almost all cities to calculate the GHG emissions that result from their electricity use. As shown in **Figure 11**, the grid mix in RFC-East has steadily shifted over the past decade away from coal (and a small amount of oil) and to natural gas. This has reduced the GHG intensity of the District's electricity, thereby reducing GHG emissions attributed to the District.

That said, as of 2014, fossil fuels still comprise over 55% of the grid mix. Furthermore, natural gas is a major source of methane emissions, which increase global warming much more significantly than carbon dioxide, potentially accelerating the onset of major climate change impacts. Nuclear fission, an emissions-free electricity source, supplied 45% of the grid mix in 2014, with small amounts of wind, solar, biomass, and hydroelectricity rounding out the picture.

²⁷ GHG Summary table maintained by DOEE.

²⁸ Sourced from note in DOEE's GHG Summary Table file.

²⁹ <https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid-questions-and-answers>



↑ **Figure 11:** Regional electricity mix (RFC-East), years available between 2004 and 2016 at the time of publication.³⁰

Note: GHG projections in Clean Energy DC are based on the RFC-East 2014 grid mix, as the 2016 data was not yet available when the GHG modeling was conducted.

³⁰ Data sourced from EPA eGRID.

2.2 MODELED IMPACTS OF RECOMMENDED ACTIONS

With a baseline of the District's energy use and emissions in hand, it is possible to project the reductions in GHG emissions, decreases in energy use, and increases in renewable energy needed to reach its targets.

As noted in Chapter 1, the consultant team developed a citywide energy and emissions model to assess the relative decarbonization impact of various actions. The team used the model to explore a variety of potential policy scenarios, consider the trade-offs of prioritizing any one of the three 2032 climate and energy goals, inform discussions regarding appropriate timelines and assumptions, and simulate the impact of potential federal policy changes.

Through this process, the *Clean Energy DC* team developed the final scenario. The sections below summarize this main scenario and the simulated energy and emissions impacts each group of actions has relative to a business-as-usual scenario. It should be noted that the model is not intended to predict the District's actual emissions to 2032. Rather, it is designed to determine the scale of action required to achieve the targets, and inform the selection and prioritization of different action options. DOEE staff can revisit and update the scenario as conditions change in the years ahead.

2.2.1 MODEL DATA AND ASSUMPTIONS

The consultant team used District-specific datasets wherever possible, and gathered additional material from sources across the northeast or, where necessary, using national figures. The model is comprised of three interrelated sectors: Buildings, Transportation, and Energy Supply. (For more information on the model and assumptions, see Appendix A1.)

2.2.1.1 BUILDINGS

In the building sector, the consulting team based energy and emissions projections on square footage; energy use intensities (EUI, or energy use per square foot of heated floor area per year); fuel mix (electricity, natural gas, fuel oil); projected construction and demolition rates; and, policy assumptions related to energy use reductions, new code and retrofit adoption rates, and years of implementation. The team grounded building-sector projections in District-specific EUIs by building category, which were primarily based on data from the District's Energy Benchmarking and Disclosure Program and the Energy Information Administration's 2012 Commercial Building Energy Consumption Survey.³¹

From these data points, the team captured two groups of actions:

New Construction Actions: The model assumes that the District Government will follow a phased approach to net-zero energy code adoption. Residential buildings that are less than 10,000 square feet are assumed to meet a net-zero code in 2020. All other residential and commercial buildings are assumed to meet a net-zero code in 2026. This assumes that new codes will impact the energy performance of new buildings three years after code adoption to account for design, permitting, and construction time. The actions recommended in Sections 4.1.2 support the District's transition to these codes.

31 <http://www.eia.gov/consumption/commercial/data/2012/>

Existing Building Actions: The *Clean Energy DC* team's model assumes continued growth in the number and impact of actions targeting energy and emissions in existing buildings. In addition to expanding the set of buildings that have taken steps to reduce energy use, this involves increasing the number of interventions that achieve deeper, lasting energy use reductions (e.g., deep energy retrofits, fuel switching).

With more flexibility and funding available to the DCSEU and the addition of a Green Bank, and building on the growing success of the DCSEU over the past few years, the District will be well-positioned to continue pushing the envelope on the energy performance of existing buildings. This is important, because the reductions modeled here require about 20% of privately-owned buildings to reduce energy use by about 40% on top of achieving the targets in the DCSEU's current five-year contract.³² This equates to a 0.75-1% decrease in total energy used by buildings across the District each year.

The District Government aims to lead the way for private building owners by targeting deep reductions in its own buildings. Under the modeled scenario, the District Government implements deep energy retrofits on District Government buildings representing approximately 9% of building floor area before 2025, while preparing for and implementing net-zero retrofits on 12.5% of buildings by floor area between 2025 and 2032.

Taken together, the primary *Clean Energy DC* scenario assumes around one in five buildings in the District will undergo some sort of energy performance improvement by 2032. (See Section 4.2.2.2 for details on conventional retrofits and deep energy retrofits. The actions recommended in Sections 4.2.3 and 4.3.1 are designed to support the District achieving this level of reductions.)

2.2.1.2 ENERGY SUPPLY

The *Clean Energy DC* team based its energy supply sector recommendations on assumptions about policy-driven changes that shift the electricity supply to renewable sources and increase thermal (heat) and electrical energy that would be supplied from new neighborhood energy systems. As noted in Section 2.1.2, the District observed a 23% reduction in GHG emissions between 2006 and 2012, more than half of which is due to the decommissioning of coal-fired power plants and other grid cleaning efforts.³³ Under the modeled scenario, energy supply policies are responsible for 46% of cumulative GHG reductions achieved by 2032. These stem from four modeled actions.

The modeled actions do not include the EPA's Clean Power Plan (CPP). Although the CPP, if implemented, would likely result in a continuation of the grid cleaning mentioned above, it does not apply directly to the District because there are no fossil-fuel power plants in the District—and, in any event, is not being implemented by EPA at this time.³⁴ While the District may benefit from the actions taken by other states under the CPP, its own RPS will also drive GHG emissions reductions, potentially further than what would be achieved through the CPP.

Here are the four key energy supply policies modeled in the Plan:

Renewable Portfolio Standard: The model simulates the District's Renewable Portfolio Standard (RPS), which requires renewable sources to deliver 50% of the electricity supplied to the District by 2032, including 5% from local solar systems.³⁵ The RPS will continue to play a vital role in achieving the District's 2032 GHG reduction target, both through direct reductions and by enabling additional reductions in buildings and vehicles that switch from fossil fuels to electricity.

³² These numbers are included to provide a reference for the scale of action required on existing buildings. In implementation, retrofits will achieve varying levels of energy use reductions across a to-be-determined proportion of the existing building stock.

³³ GHG Summary Table maintained by DOEE.

³⁴ FACT SHEET: Clean Power Plan Framework, <https://www.epa.gov/cleanpowerplan/fact-sheet-clean-power-plan-framework>

³⁵ Renewable Portfolio Standard Expansion Amendment Act of 2016. 2015 Quarterly State of the Market Report for PJM: January through March, p.248, http://www.monitoringanalytics.com/reports/PJM_State_of_the_Market/2015/2015q1-som-pjm-sec8.pdf

Excluding the local solar requirements, under the modeled scenario the RPS is responsible for delivering approximately 20% of cumulative GHG reductions by 2032. The specific level of reductions will depend in part on how electricity suppliers comply with the RPS. As discussed in further detail in Chapter 5, the District's RPS allows electricity suppliers to comply by (1) using renewable energy certificates (RECs) sourced from within the PJM Interconnection Region (PJM) or a state adjacent to PJM,^{36,37} or (2) making alternative compliance payments (ACPs) to the District based on the portion of the RPS requirement that cannot be satisfied with RECs.

Although funding from any ACPs is used to support the District's Solar for All program, these payments cannot be attributed with direct GHG reductions. While RECs can be attributed with GHG reductions, not all RECs under the RPS are eligible for GHG reductions under ICLEI's U.S. Community Protocol for Accounting and Reporting Greenhouse Gas Emissions, the industry-standard GHG accounting protocol used by the District.³⁸ The ICLEI Protocol requires a city to calculate GHG emissions based on the best information it has about the source of the electricity it consumes. For this, the District uses the GHG intensity of its regional grid: the EPA eGRID factor for the RFC-East sub-region.³⁹ Because the RPS allows suppliers to comply using RECs from outside the EPA's RFC-East eGRID sub-region, not all RECs used to comply with the RPS will lead to GHG emissions that the District can account for in future GHG inventories. The model (and Figure 12 in section 2.2.2.1) assumes that 57% of the RPS leads to GHG reductions that can be attributed to the District's GHG inventory under the ICLEI

Protocol requirements.⁴⁰ The actual GHG impact of the RPS will depend on how it is designed and managed as renewable energy requirements increase, as discussed in Action CRE.1.

Renewable Portfolio Standard Local Solar Requirement:

The current RPS requires that locally-produced solar supply 5% of electricity consumed within the District in 2032. Whereas the rest of the RPS allows RECs sourced from outside PJM, the local solar requirement must be complied with using solar RECs (SRECs) from solar systems located within the District or connected to distribution line directly connected to the District. Furthermore, all funding from ACPs is used to support local solar installations. For these reasons, the modeled scenario attributes 100% of GHG reductions stemming from the RPS's local solar requirement to the District. Under the modeled scenario, this equates to 4% of cumulative emissions reductions by 2032.

Power Purchase Agreement for Standard Offer Service:

The model assumes that the current Standard Offer Service (SOS) will use a mix of short-term and long-term energy supply contracts, including a power purchase agreement (PPA), with one or more energy suppliers to provide renewable for 70% of the SOS beginning in 2019. The SOS is the electricity purchased for those District ratepayers who do not choose a competitive supplier for their electricity. The SOS currently provides approximately 24% of the District's electricity.⁴¹ To be conservative, the model assumes 10% of customers choose to opt-out of the new SOS, which then supplies 21.6% of the District's electricity consumption (Action CRE.2). The new, renewable energy-driven

36 Clean and Affordable Energy Act of 2008, http://doee.dc.gov/sites/default/files/dc/sites/ddoe/publication/attachments/CAEA_of_2008_B17-0492.pdf

37 The RPS further rules clarify that states within the PJM Interconnection Region currently include Delaware, the District of Columbia, Illinois, Indiana, Kentucky, Maryland, Michigan, New Jersey, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia and West Virginia, and states adjacent to the PJM Interconnection Region include Alabama, Arkansas, Georgia, Iowa, Mississippi, Missouri, New York, South Carolina, and Wisconsin. Public Service Commission of the District of Columbia, Report on the Renewable Energy Portfolio Standard for Compliance Year 2015, May 2, 2016, http://www.dcpsc.org/getmedia/901b3c18-4859-435d-ae1a-ca296584c26b/ghamis_542016_831_1_FC_-_945_-_2016_-_E_-_REPORT.aspx.

38 ICLEI - Local Governments for Sustainability is the leading global network of more than 1,500 cities, towns and regions committed to building a sustainable future. ICLEI's U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions, <http://www.ghgprotocol.org/city-accounting>

39 The U.S. Environmental Protection Agency's eGRID factor for RFC-East subregion for 2014 (accessed January 20, 2016). http://www.epa.gov/sites/production/files/2015-07/documents/emission-factors_2014.pdf

40 This assumption is based on discussions with DOE representatives and the finding that 57% of all non-hydroelectric renewable energy capacity built in the United States since 2000 is being used to comply with RPS requirements. This does not apply to the local solar requirement. Finding sourced from: Lawrence Berkeley National Laboratory (LBNL) and National Renewable Energy Laboratory (NREL), 2016. "A Retrospective Analysis of the Benefits and Impacts of U.S. Renewable Portfolio Standards." <https://emp.lbl.gov/sites/all/files/lbnl-1003961.pdf>; Barbose, Galen. Lawrence Berkeley National Laboratory, April 2016. "U.S. Renewables Portfolio Standards: 2016 Annual Status Report." <https://emp.lbl.gov/sites/all/files/lbnl-1005057.pdf>

41 Correspondence with DOE staff on Aug 1, 2016.

SOS procurement should be phased in over three years, affecting an additional third of the SOS in each year. By 2032, the PPA for SOS provides approximately 20% of cumulative emissions reductions by 2032.

Neighborhood-Scale Energy: The model assumes that five neighborhood-scale thermal energy systems are installed between 2020 and 2028.⁴² Wastewater thermal resources identified by DC Water would supply these systems to the tune of 37 MW. The model also includes GHG reductions estimated from the development of two microgrids at Walter Reed Army Medical Center and St. Elizabeth's Campus.⁴³ Actions CRE.7 and CRE.8 aim to support the development of these systems.

2.2.1.3 TRANSPORTATION

Finally, energy and emissions in the transportation sector are determined using estimates of vehicle miles traveled;⁴⁴ vehicle fuel efficiencies; fuel GHG intensities; a breakdown of use by mode of transportation; and rates of electric vehicle uptake. The consultant team included four primary sets of actions relevant to the transportation sector in the model:

Corporate Average Fuel Economy (CAFE) Standard: The CAFE standard is a federal fuel efficiency and GHG emissions standard applied to light duty (i.e., passenger) vehicles. While this regulation is beyond the District Government's control, it has a significant impact on GHG emissions from transportation and will likely play a key role in achieving the District's energy use and GHG reduction targets. Because it is a federal regulation already in place, the CAFE Standard will achieve GHG reductions regardless of actions taken by the District, with its impact varying based on the District's success with mode-share change. However, the CAFE Standard is one of several federal climate and energy policies considered at risk of being weakened

or rescinded, potentially impacting the District's ability to achieve its targets. The *Clean Energy DC* team thus included it in the GHG and energy use reduction figures to make its impact explicit to readers.

Mode Share Change: The model assumes the District will achieve its 2032 mode share target of 50% transit, 25% walking and biking, and 25% driving, as set out in the *Sustainable DC* plan. The actions required to achieve these reductions are beyond the Plan's scope. (The *moveDC* Plan addresses mode share.)

Electric Vehicle Adoption: The District will not achieve its 2050 carbon neutral commitment without widespread vehicle electrification. However, due to the length of time required to transition the existing, largely gasoline-powered fleet to zero emission electric vehicles, the team recommends the District prioritize this action in the near-term. The modeled scenario assumes that 30% of new vehicles sold in 2030 will be electric, up from less than 1% in 2015. Because vehicles are typically on the road for more than a decade, the GHG reduction achieved in 2032 depends on the proportion of electric to conventional (i.e., gasoline internal combustion engine) vehicles sold from now on, with their importance growing each year.

Transit Bus Fleet Electrification: This Plan and *moveDC* both seek a significant shift away from passenger vehicles and towards public transit, among other commuting options. Although a significantly smaller source of GHGs than personal vehicles, electrifying a growing portion of DDOT's and WMATA's transit fleet can make an important contribution to mitigating climate change, particularly as transit use increases. Since they emit no pollutants, electric buses do not contribute to local air pollution. The positive impacts of electric buses on local air pollution were also modeled; those results can be found in Appendix A1.

⁴² Neighborhood-scale energy systems are also commonly referred to as district energy systems.

⁴³ The District is currently investigating and is actively engaged in maximizing the utilization of cost-effective microgrid opportunities. Once more information is available, the next iteration of the Plan can incorporate the potential impact of these opportunities.

⁴⁴ This includes all vehicle miles traveled in the District, regardless of origin or destination.

2.2.2 ACHIEVING THE DISTRICT'S 2032 TARGETS

The model demonstrates that, when implemented together, the actions recommended in Chapters 3 to 6 can meet and exceed the District's 2032 GHG reduction target. These actions will not, however, achieve the District's 2032 energy use reduction or renewable energy utilization targets. During the energy and emissions modeling process, the consultant team discovered the relative difficulty of achieving the District's energy-use-reduction and renewable-energy-utilization targets, and particularly of achieving all three targets simultaneously. This is because that GHG emissions reductions can be achieved both through improving energy performance and decarbonizing energy sources. Conversely, energy use is generally unaffected by actions focused on decarbonizing energy sources.⁴⁵

The consultant team presented this finding to representatives of DOEE during a collaborative engagement session, along with the assumptions underlying the model, and the group collectively decided to prioritize the GHG reduction target over the other targets in this Plan. In doing so, the District can focus its limited resources on the target with that offers the greatest opportunity to avoid significant climate impacts.

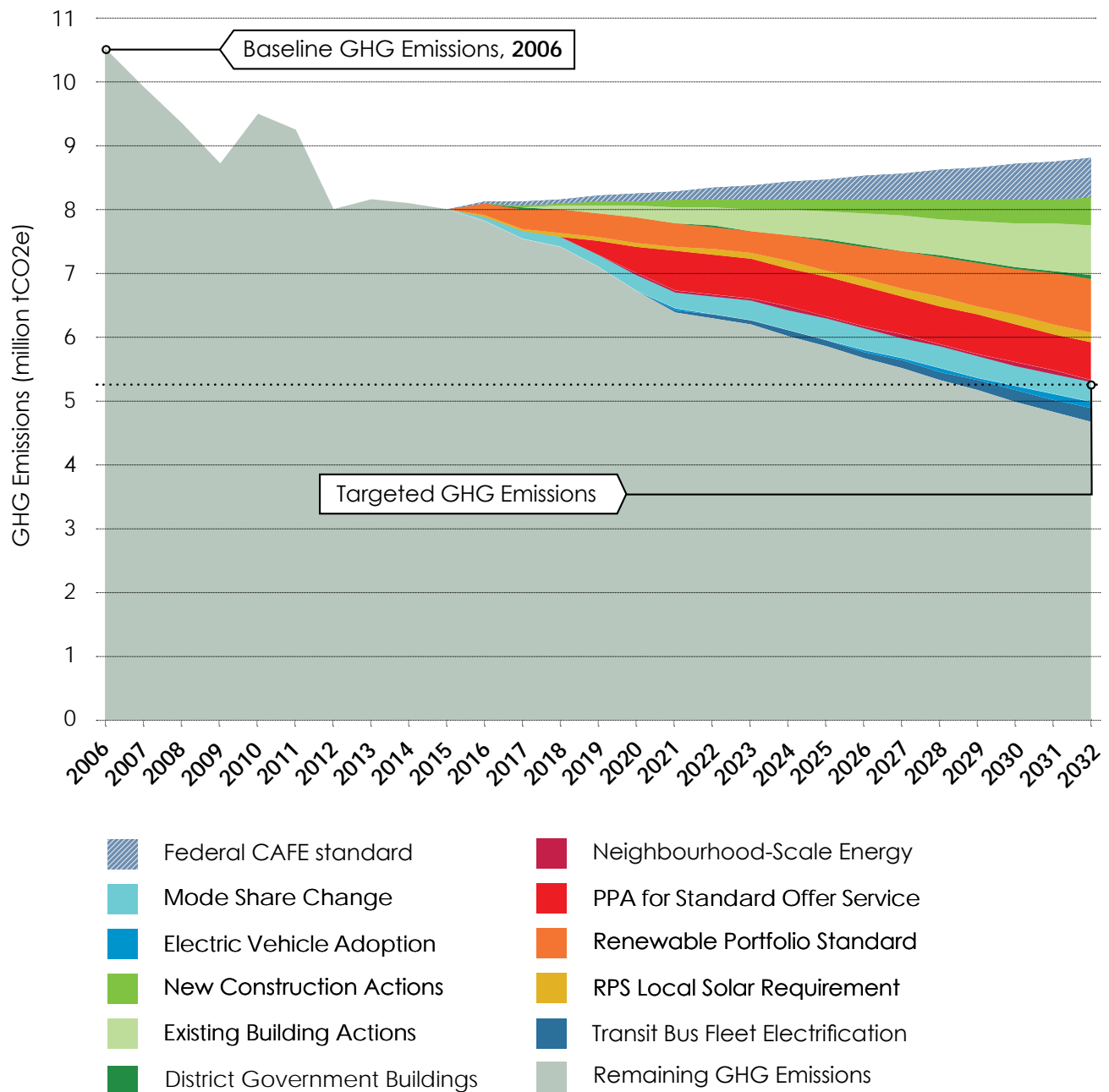
2.2.2.1 ACHIEVABLE GHG EMISSIONS REDUCTIONS

The model demonstrates that when implemented together, the actions recommended in the Plan achieve an estimated 56% reduction in GHG emissions relative to 2006. **Figure 12** and **Figure 13** present projected GHG reductions achieved by actions targeting buildings, transportation, and the energy supply. Notice that GHG emissions have declined since 2006. This is due primarily to coal plant closures that reduced the GHG intensity of electricity consumed in the District. Notice also that, absent federal efforts to improve vehicle efficiency (the top line of the CAFE Standard wedge in **Figure 12**), GHG emissions are projected to increase between now and 2032, due to population and economic growth in the District.⁴⁶

Accounting for the decline in GHGs since 2006 and their projected future increases, the District must take enough action to avoid approximately 40% of the GHG emissions projected in the year 2032 to reduce them 50% relative to 2006. As noted above, the actions recommended in this Plan can exceed that. Table 1 summarizes the total GHG emissions avoided in 2032 relative to the business as usual scenario and attributes these reductions to actions in different sectors.

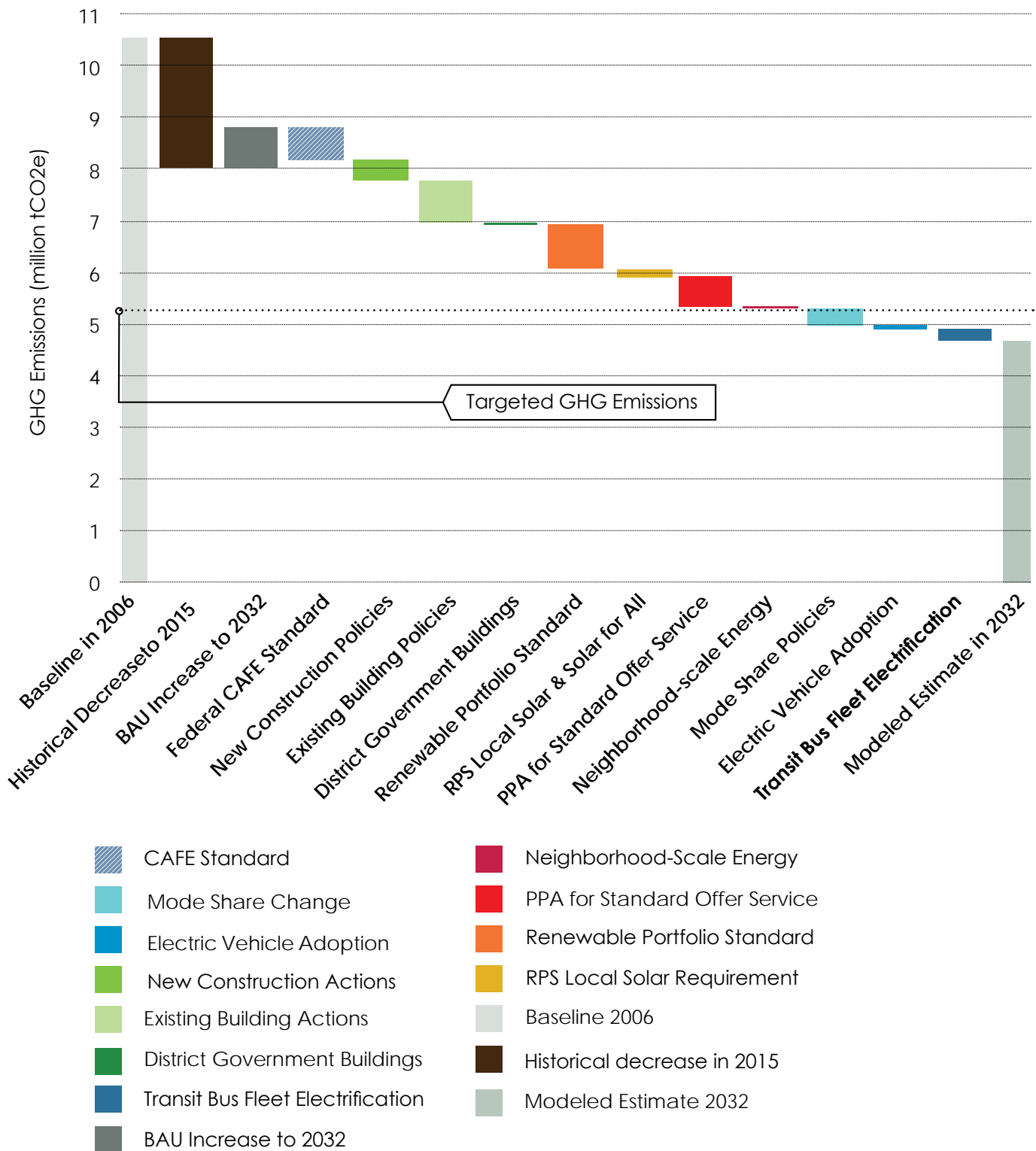
⁴⁵ Energy use reductions can in some cases be achieved through decarbonizing energy sources. For example, if using source instead of site energy, energy consumptions may be reduced by decarbonization actions that shift electricity generation from centralized fossil fuel generators far outside the District to renewable energy sources closer to the District.

⁴⁶ As discussed in section 2.2.1.2, external forces will likely result in the GHG intensity of the grid declining, such as through the implementation of the federal Clean Power Plan, the EPA's mercury regulations, and declining renewable energy costs. To avoid overestimating GHG reductions, these forces are not included in the BAU projection. These forces will drive the same type of grid cleaning that the District's RPS will, so including both without a good understanding of interaction effects would result in double counting emissions reductions.



↑ **Figure 12:** Wedge diagram showing projected GHG reduction path from Clean Energy DC actions

Note: All figures use GHG intensity factors that account for losses from generation and transmission. See section A1.2.2.1 in Appendix A1 for more detail. CAFE Standard = Corporate Average Fuel Economy Standard; PPA = power purchase agreement; RPS = Renewable Portfolio Standard.



↑ **Figure 13:** Waterfall diagram showing each action area's contribution to projected reductions in 2032

Note: All figures use GHG intensity factors that account for losses from generation and transmission. CAFE Standard = Corporate Average Fuel Economy Standard; PPA = power purchase agreement; RPS = Renewable Portfolio Standard.

Modeled GHG Reduction Actions	GHGs Reduced from 2032 BAU (tCO ₂ e)	Percent GHGs Reduced from Total 2032 BAU*
Federal CAFE Standard	626,000	7.10%
New Construction Policies	408,000	4.60%
Existing Building Policies	797,000	9.00%
District Government Buildings	45,000	0.50%
Renewable Portfolio Standard	841,000**	9.5%**
RPS Local Solar Requirement	164,000	1.90%
PPA for Standard Offer Service	584,000	6.60%
Neighborhood-Scale Energy	49,000	0.60%
Mode Share Change	320,000	3.60%
Electric Vehicle Adoption	76,000	0.90%
Transit Bus Fleet Electrification	230,000***	2.60%***
Total GHGs Avoided vs. 2032 BAU	4,140,000	47.00%
Historical GHGs Avoided 2006-2015 vs. 2006 Baseline	2,509,000	23.8%
BAU Increase in GHG emissions 2016 to 2032	784,000	N/A
Total GHGs Avoided vs. 2006 Baseline	5,870,000	55.70%

↑ **Table 1:** *Clean Energy DC* Relative contributions of *Clean Energy DC*'s emissions-reducing actions.

Note: All figures based on site energy use, and use GHG intensity factors that account for losses from electricity generation, transmission, and distribution, as well as fugitive emissions from natural gas distribution. See Appendix A1 for more detail

*This column measures the percentage reduction in total GHG emissions from the 2032 level under the business as usual scenario. For example, New Construction actions decrease total District-wide 2032 GHG emissions by 4.6%. Due to GHG declines between 2006 and 2015, as well as projected GHG increases between 2015 and 2032, the District must avoid 40% of projected GHGs in 2032 to decrease GHG emissions 50% relative to 2006.

**The RPS savings assume that the District captures 57% of the total potential GHG reductions possible under the RPS from generation outside the District borders. See section 2.2.1.2.

*** Savings from transit bus fleet electrification also reflect increased use of busses due to mode share change.

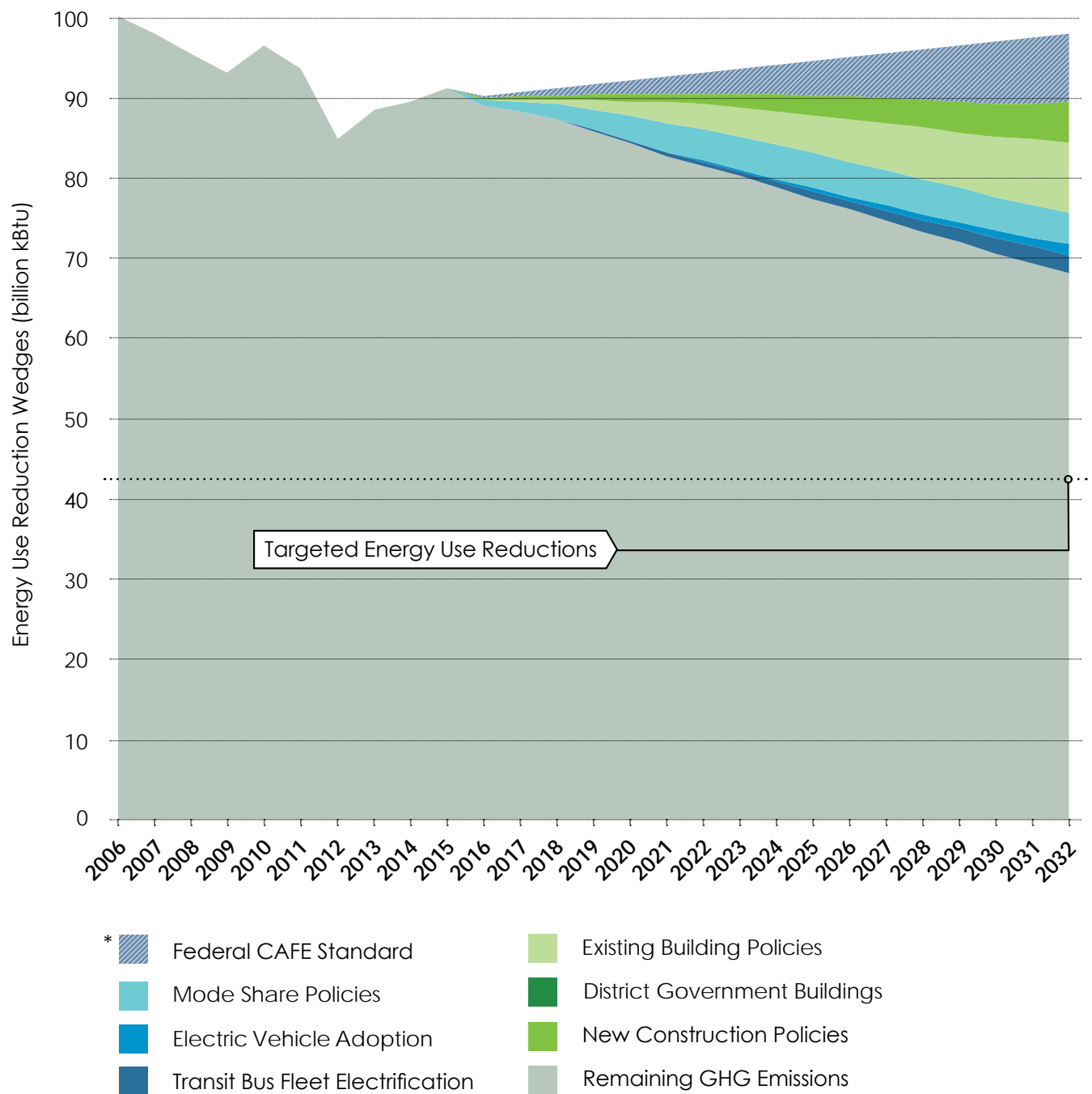
2.2.2.2 ACHIEVABLE ENERGY USE REDUCTIONS

In addition to a decrease in GHG emissions, the model simulation also indicates an anticipated decline in energy use of 20% relative to the District's 2012 energy baseline (or 32% below 2006, the GHG target baseline year). If considering projected population growth, this reduction translates to a 42% decline in energy use per capita relative to 2012 (57% decline from 2006). Considering buildings, the average energy use intensity of buildings in the District declines 13.5% relative to 2012 (26.7% relative to 2006).⁴⁷

Figure 14 presents projected energy use reductions according to different action areas, while Table 2 summarizes the total energy use that will be avoided in 2032 and a measure of the energy use avoided compared to the business-as-usual scenario in 2032. Note that the energy supply wedges from Table 1 do not appear in Table 2, as they do not reduce site energy use, but instead decarbonize parts of the District's energy supply.

Decreases in gasoline and diesel consumption account for the majority of energy-use reductions in the District. This primarily stems from the significant shift away from passenger vehicles in favor of walking, cycling, and public transit, with additional support from the federal CAFE standard, electric vehicle adoption, and electrifying transit buses. The District sees less substantial reductions in natural gas and electricity. Through actions focused on new construction, existing buildings, and transit buses, natural gas declines by approximately 15% from 2015. Electricity declines only 3.6% over the same period, as reductions in the aforementioned areas are tempered by the increase in demand driven by the electrification of passenger vehicles, transit buses, and building heating systems.

⁴⁷ Energy use intensity (EUI) is equal to the amount of energy consumed in a building, per square foot, per year.



↑ **Figure 14:** Projected site energy use reductions from recommended actions.

Note: All figures based on site energy use. Historical data is the same as that presented in section 2.1. CAFE Standard = Corporate Average Fuel Economy Standard.

	Site Energy Use Reduced from 2032 BAU (million kBtu)	Percent Site Energy Use Reduced from Total 2032 BAU*
Federal CAFE Standard	8,458	8.60%
New Construction Policies	4,911	5.00%
Existing Building Policies	8,764	8.90%
District Government Buildings	4,818	1.70%
Mode Share Policies	3,956	4.00%
Electric Vehicle Adoption	1,350	1.40%
Transit Bus Fleet Electrification	2,214**	2.20%**
Total Energy Use Avoided vs. 2032 BAU	30,134	30.60%
Total Energy Use Reduced vs. 2012 Baseline	16,732	19.7%

↑ **Table 2:** Relative contributions of *Clean Energy DC*'s energy-reducing actions.

Note: All figures use site energy numbers. As explained elsewhere, all reported energy figures use site energy, while GHG emissions use source GHG intensity factors that account for losses from generation, transmission, and distribution. See section A1.2.2.1 in Appendix A1 for more detail.

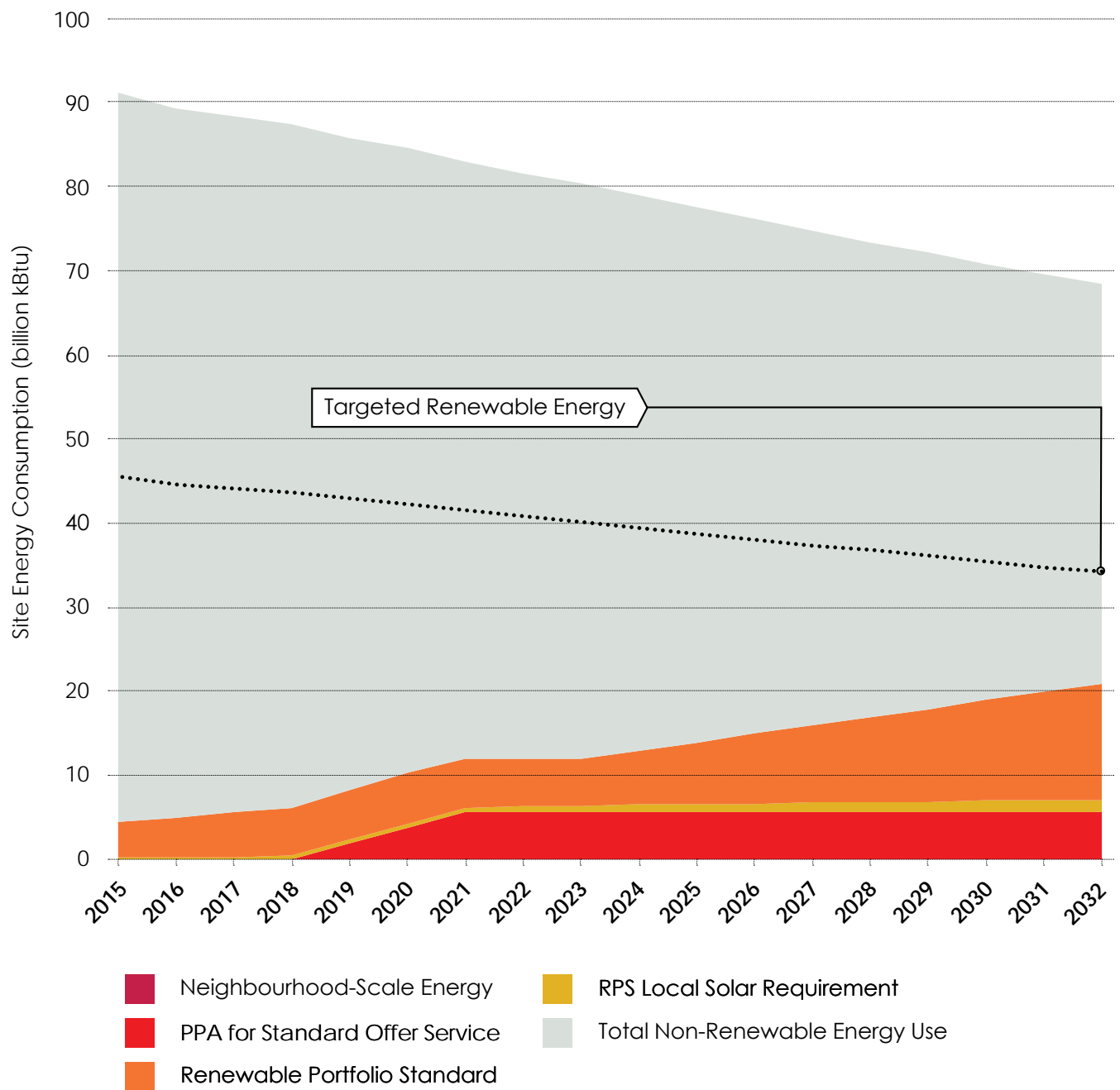
*This column measures the percentage reduction in total energy consumption that a single action area drives relative to the total BAU energy use in 2032. As with GHG emissions, projected growth in energy consumption between 2012 and 2032 dictates what the District must accomplish to achieve its 2032 energy use reduction target. Based on growth in energy consumption since 2012 (the baseline year), as well as continued growth in projected energy consumption, the District must avoid 57% of its BAU energy consumption in 2032 to reduce energy consumption by 50% relative to 2012.

***Savings from transit bus fleet electrification also reflect increased use of busses due to mode share change.

2.2.2.3 ACHIEVABLE INCREASES IN RENEWABLE ENERGY

The model also estimates the proportion of renewable energy that will comprise the District's total energy supply in 2032. Unlike the District's GHG reduction and energy use reduction targets, the renewable energy target will shift according to the total quantity of energy used. As the District achieves deeper energy use reductions, the total quantity of renewable energy required to meet the target will decrease. **Figure 15** presents the proportion of renewable energy that will contribute to the District's total energy use, while the renewable energy generation required to achieve these targets is summarized in Table 3.

The model shows that by adopting the recommended actions, 30% of the District's total energy use in 2032 will come from renewable sources. While the actions do not fully achieve the 50% renewable energy target, they would significantly increase the amount of renewable electricity consumed.



↑ **Figure 15:** Projected utilization of renewable energy as a result of recommended actions.

Note: RPS = Renewable Portfolio Standard; PPA = Power Purchase Agreement

	Renewable energy utilized in 2032		Estimated generation capacity required in 2032 (MW)*
	million kBtu	percent of total energy use	
Renewable Portfolio Standard	13,773	20.20%	1,002–2,574
RPS Local Solar Requirement	1,530	2.20%	379
PPA for Standard Offer Service	5,452	8.00%	397–1,019
Neighborhood-Scale Energy	157**	0.20%	37**
Total Renewable Energy	20,912	30.60%	1,813–4,009

↑ Table 3: Projected renewable energy consumption and supply requirements.

Note: Based on site energy use. As explained elsewhere, all reported energy figures use site energy, while GHG emissions use source GHG intensity factors that account for losses from generation, transmission, and distribution. See section A1.2.2.1 in Appendix A1 for more detail.

*Required generation capacities are based on assumptions about capacity factors: 47.4% for neighborhood energy wastewater thermal (based on DC ENERGIZED), a low of 17.9% (utility-scale solar photovoltaic) to a high of 46.0% (offshore wind) for RPS outside the District, and 13.0% for solar rooftop photovoltaic within the District (based on GDS Associates for the District Department of the Environment, Renewable Energy Technologies Potential for the District of Columbia, 2013).

**This does not include the Walter Reed or St. Elizabeths neighborhood-scale energy systems because they are not fully renewable energy.

The image features a black and white photograph of a two-story house with horizontal siding and a central window with shutters. The roof is covered with solar panels, and a satellite dish is mounted on it. The photograph is framed within a circular cutout on a solid orange background. Above the house, several light orange diagonal streaks of varying lengths suggest falling rain. A white rectangular box is positioned at the bottom right of the circular frame, containing the text 'AN EQUITABLE TRANSFORMATION' in a bold, orange, sans-serif font.

AN EQUITABLE TRANSFORMATION

3 AN EQUITABLE TRANSFORMATION

In the context of climate and energy planning, social equity is a relatively new area of study. Governments are beginning to formally consider equity in such plans out of a recognition and acknowledgement that extreme climate events such as floods, fires, and severe storms disproportionately impact some communities more than others.⁴⁸ Though climate change is a global and societal challenge, some groups of people shoulder its burden more heavily than others.

Advocates use the term “climate justice” to characterize the climate-change conversation as viewed through a human rights lens. Equitable climate action is a tenet of climate justice, and focuses on providing support to those disproportionately affected, and ensuring equal access to social benefits and opportunities. The Government Alliance for Race and Equity defines (racial) equity on outcome-based terms: “the achievement of racial equity is when race can no longer be used to predict life outcomes, and outcomes for all groups are improved.”⁴⁹ Climate equity echoes a similar sentiment. By integrating equity into climate-action planning, the District hopes to ensure that racial and ethnic grouping and socioeconomic status are not predictors of relative vulnerability to climate impacts. In the context of Clean Energy DC, equity will refer to this working definition.

DOEE recently convened an “Equity and People” Working Group to review the *Sustainable DC* plan.⁵⁰ This group is collaboratively developing a more refined and precise definition of equity specific and relevant to the citizens of the District. Once that definition is finalized, it will supersede the current working definition used in this Plan.

The following sections delve deeper into the importance of planning for equity, the causes of inequity in relation to climate change impacts, and the process undertaken in the review of *Clean Energy DC* to identify and reframe any actions included in the plan that could present inequitable outcomes.

⁴⁸ USDN. Guide to Equitable, Community-Driven Climate Preparedness Planning. May 2017

⁴⁹ Racial Equity Alliance. Racial Equity Action Plans: A How-To Manual. <http://www.racialequityalliance.org/wp-content/uploads/2016/11/GARE-Racial-Equity-Action-Plans.pdf>

⁵⁰ www.sustainabledc.org

3.1 WHY EQUITY?

It is important to plan for equity for many reasons. It is now clear that climate change affects all population groups and communities, but affects some more than others. On a global scale, the bulk of the GHG emissions that drive climate change are created by wealthier nations, while the impacts are largely shouldered by poorer nations. Cities serve as a microcosm of this imbalance, even in wealthy nations such as the United States. Wealthier people and large companies generate a disproportionate amount of emissions, while poorer populations are often ill-positioned to respond to the impacts, or benefit from mitigation and adaptation measures. At-risk populations are more exposed to climate hazards, have less capacity to adapt to climate hazards, and have increased sensitivity to those hazards.⁵¹ Studies show low-income populations, people of color, immigrants and refugees, are most at-risk to be affected by climate change impacts.⁵² These vulnerable populations, or “frontline communities,” are often disadvantaged because of a lack of resources, reduced access to benefits or information, or due to structural and reinforced racism.

In 2015, the aftermath of Hurricane Katrina offered a textbook example of this increased climate impact sensitivity in communities of color. When the storm hit New Orleans, that city’s communities of color were underprepared and under-resourced—a situation that had been exacerbated by disinvestment in public infrastructure and vulnerable living standards.⁵³ Diligent, deliberate planning efforts can help prevent a repeat of the tragedies that occurred in Louisiana, while creating a fair community for everyone.

Historically, the inequities seen in American society today are to a large degree the result of past government decisions nationwide.⁵⁴ For example, “redlining” is the racist practice of excluding people of color from accessing public services by directly removing them, selectively raising housing prices, or selectively providing financial aid. The Home Owner’s Loan Corporation (est. 1933) and the Federal Housing Administration (est. 1934), two political bodies, historically withheld mortgage loans from communities of color, a practice that contributed greatly to residential racial segregation, impacts that continue to this day.⁵⁵

These truths underscore the imperative for governments to account for climate equity when drafting climate and energy policies, and plans such as this one. For example, in planning for improved energy efficiency, risks exist that the costs of retrofit compliance codes may place added pressure on rents. Similarly, financing may be inaccessible to communities that traditional financial institutions have historically designated as lower class and higher risk. Race and ethnicity are the most powerful signifying factors of communities facing financial hardship. In the District, Black and Latino households negatively bear the impacts of redlining, visible even at the middle- to upper-middle income levels. This institutional racism has created extreme wealth and income gaps between White and non-White households in the District.⁵⁶

Policy has an immense capacity to shape society, and acknowledging this responsibility in Clean Energy DC is the first step toward creating an equitable energy-system transformation. In recognizing these inequities, the District should create actions to directly support to at-risk communities including low-to-middle income (LMI) populations and populations of color.

51 USDN. Guide to Equitable, Community-Driven Climate Preparedness Planning. May 2017

52 OHCHR. Understanding Human Rights and Climate Change. <http://www.ohchr.org/Documents/Issues/ClimateChange/COP21.pdf>

53 Zoraster, RM. Vulnerable populations: Hurricane Katrina as a case study. <https://www.ncbi.nlm.nih.gov/pubmed/20405467>

54 EPI. The racial wealth gap: How African-Americans have been shortchanged out of the materials to build wealth. <http://www.epi.org/blog/the-racial-wealth-gap-how-african-americans-have-been-shortchanged-out-of-the-materials-to-build-wealth/>

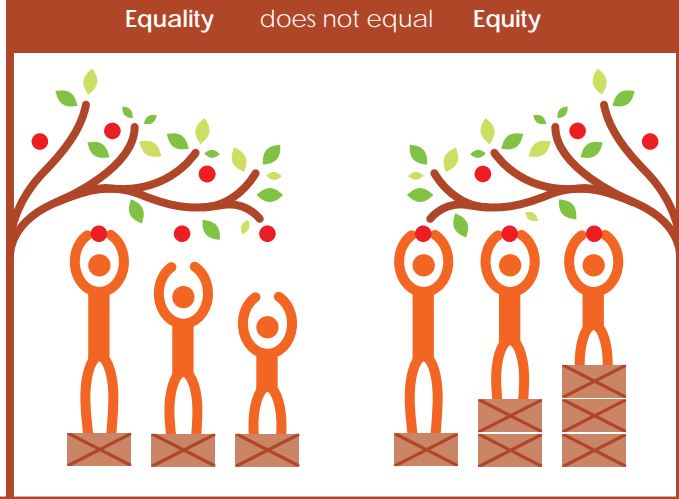
55 NCRC. HOLC “Redlining” Maps: The persistent structure of segregation and economic inequality. https://ncrc.org/wp-content/uploads/dlm_uploads/2018/02/NCRC-Research-HOLC-10.pdf

56 EPI. Racial gaps in wages, wealth, and more: a quick recap. <http://www.epi.org/blog/racial-gaps-in-wages-wealth-and-more-a-quick-recap/>

It is important to note the differences between equity and equality.

"Equality" refers to the practice of ensuring equal provision of services to all. For example, financial institutions create and sustain inequality by withholding mortgage loans to Black communities.

Meanwhile, "equity" refers to the practice of providing equal access to opportunity and services, or equal possession of basic needs. For example, an online-only job board creates inequity between those with access to regular internet service, and those without. Note: Inequality can breed inequity. Inequity can be created over time, as unequal service provision favors one group over another.



↑ **Box 3:** Language matters: The difference between equality and equity.

3.2 EQUITY IN THE CONTEXT OF THE DISTRICT

In the District, income inequality is visibly evident in the District, with an East-West divide that runs north to south—historically, the dividing line was approximately 16th Street NW, though this is changing, and some neighborhoods, like Capitol Hill, are exceptions. In 2016, the national median household income was \$59,039, whereas the Metro region of the District has a household median income of \$72,935.⁵⁷ The following map shows that neighborhoods west of the 16th Street divide have, by and large, much higher incomes than the national average, whereas neighborhoods to the east have household incomes much lower than the national average.

Racial segregation in the District corresponds closely to the east-west income equality divide. Caucasians and African Americans constitute most of the District's population, making up 44.6% and 47.7% of the total population respectively,⁵⁸ with the majority of Caucasians living west of the divide, and most African Americans living east of the divide. This divide is heightened by uneven job distribution in the District. The citywide unemployment rate Wards 1-6, west of the Anacostia River, was 4.9%, and the rate in Wards 7 & 8, east of the Anacostia River, was 11.6%.⁵⁹

Racial segregation has long been ingrained into the District's neighborhoods,⁶⁰ from the post-Civil War segregation era to the present day. The following map depicts this striking division.

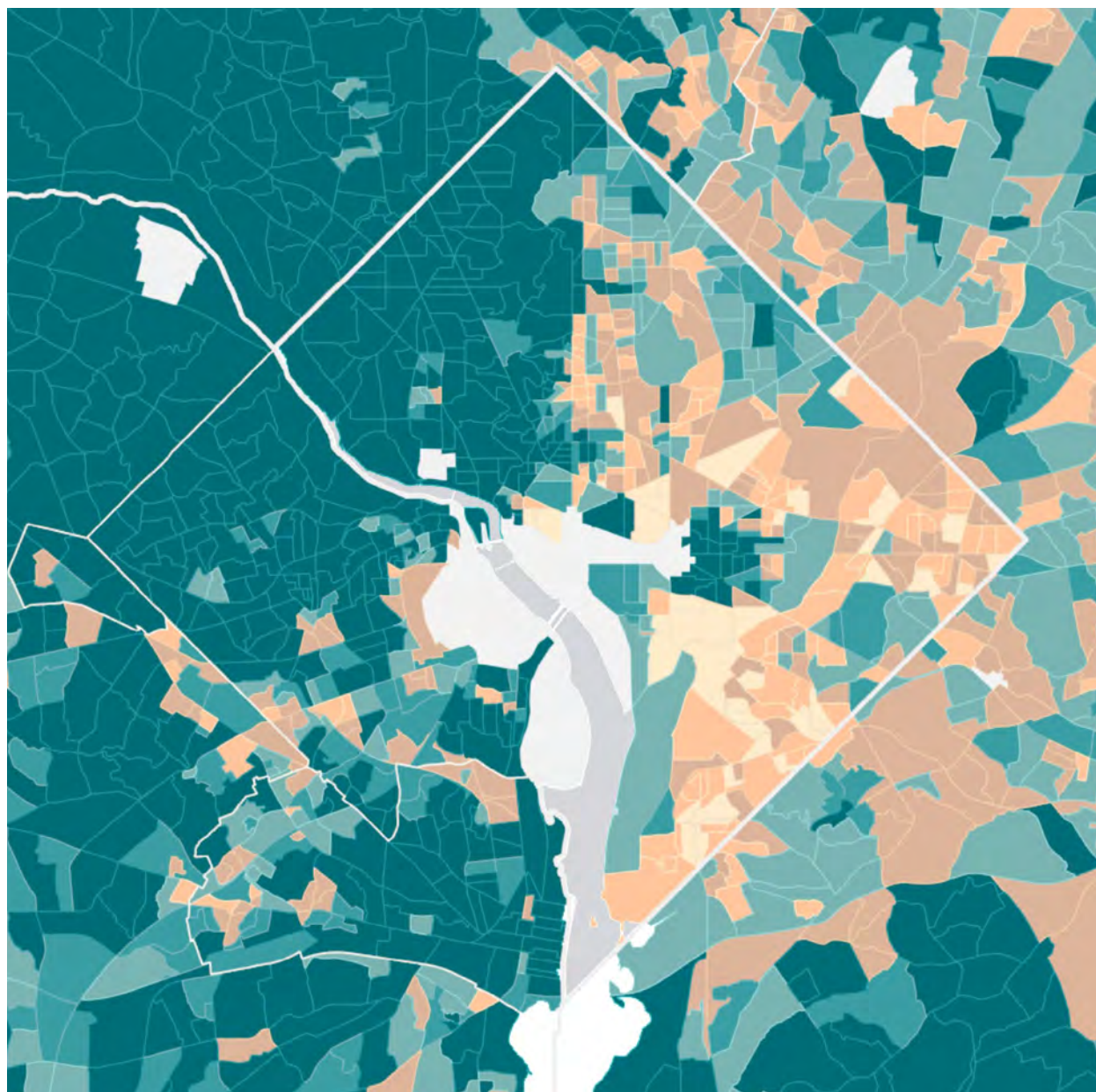
⁵⁷ <https://www.census.gov/quickfacts/DC>

⁵⁸ US Census Bureau. "District of Columbia." 2016

⁵⁹ "Unemployment Data for DC Wards" Department of Employment Services, Government of the District of Columbia, <https://does.dc.gov/page/unemployment-data-dc-wards>

⁶⁰ Pritchett, Wendell. "A National Issue: Segregation in the District of Columbia and the Civil Rights Movement at Mid-Century." 2005

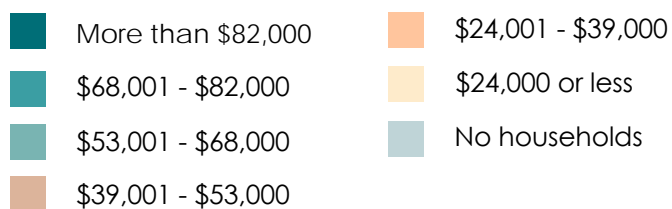
INCOME EQUALITY IN WASHINGTON, DC



Median Household income, 2012

Census Block Groups

US median: \$50,157

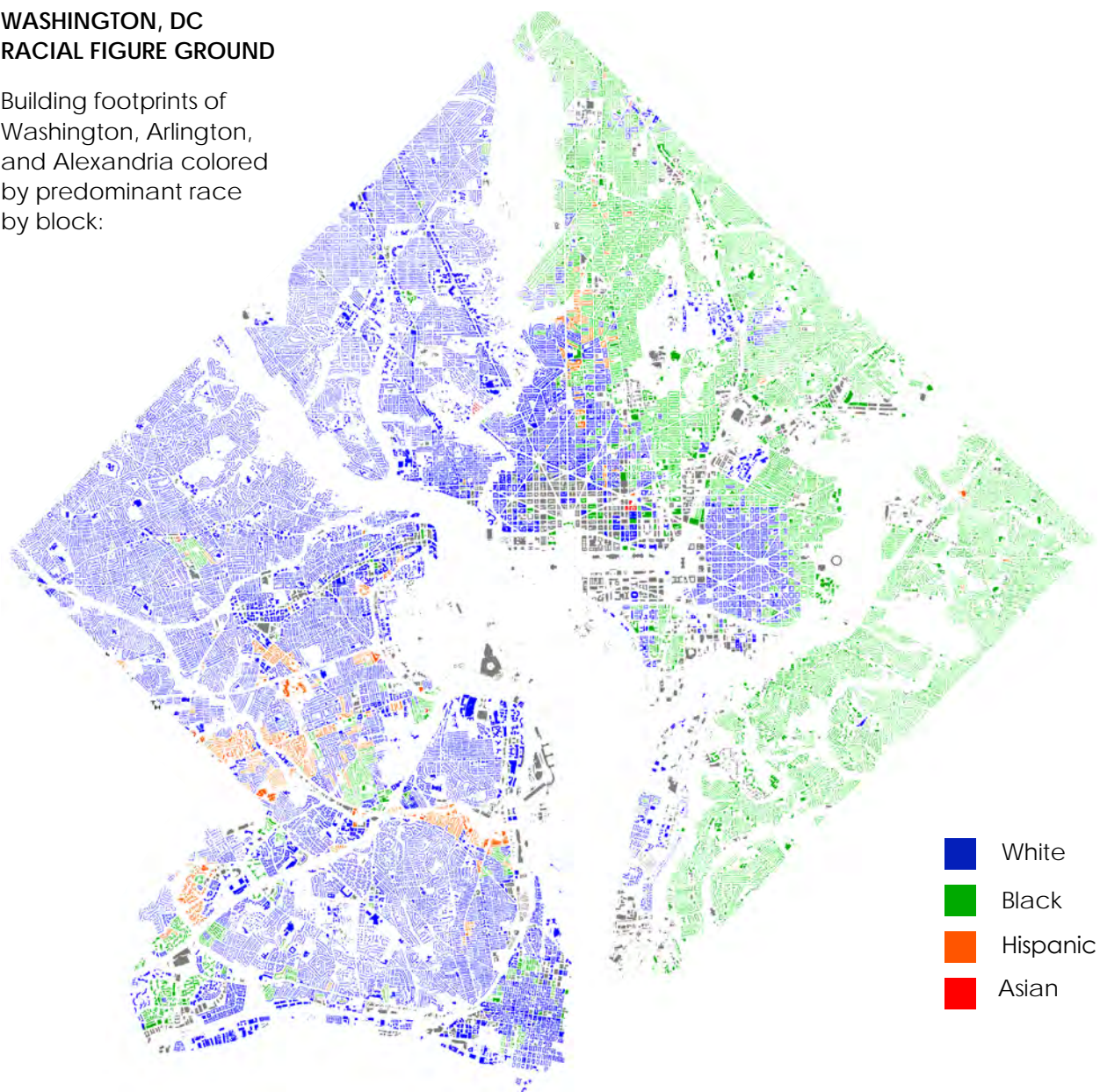


↑ **Figure 16:** Income inequality in the District (ESRI 2017).⁶¹

61 ESRI. "Income Inequality in Washington, D.C." July 2017

WASHINGTON, DC RACIAL FIGURE GROUND

Building footprints of
Washington, Arlington,
and Alexandria colored
by predominant race
by block:



↑ **Figure 17: Racial Segregation in the District** (Kenton Ngo 2015)⁶²

The University of Virginia has created an interactive, though less recent, geographic information system (GIS) map of racial segregation in the United States.⁶³

The income disparity and racial segregation seen today are the product of years of structural inequality. Marginalized groups have faced, and continue to face, barriers that become positive reinforcing loops that solidify and amplify social inequity. These groups face unequal opportunity and low access to financial support, education, and/or information that might promote movement up the social ladder or lead to a higher income. When drafting the Plan, the team worked with local and national experts to identify and address any ways in which its recommendations could create or further reinforce structural inequalities. These specific changes are discussed further below.

⁶² Ngo, Kenton. "The Figure-Ground of Race in Washington, DC." 2015

⁶³ <https://demographics.virginia.edu/DotMap/index.html>

3.3 EQUITY AND CLIMATE ACTION

3.3.1 CENTERING EQUITY IN PLANNING PROCESSES

As previously stated, the practice of including equity in climate change action plans is relatively new, but many cities are now accounting for climate change inequities when planning to reduce their greenhouse gas emissions and energy use, and increase renewable energy production.

The City of Portland, the City of Seattle, and the City of Cleveland are all leaders in this field. When planning for climate action and sustainability, these cities have also incorporated planning for equity into their processes. Notably, they have included and engaged with at-risk communities that may disproportionately bear the burden of climate change impacts, and that may be negatively impacted by mitigation actions. Such robust stakeholder engagement is essential. The partnership and capacity-building work recommended in Action EQ.1 builds on these examples.

3.3.2 JOB CREATION

Clean energy and energy efficiency jobs are growing at a much faster pace than the rest of the economy, and the same is true in the District. According to the U.S. Department of Energy, there are 12,000 people employed in energy efficiency in the District of Columbia; the majority of those jobs are in construction and installation. Another 1,700 employed in renewable energy, primarily in solar energy; one-third are employed in direct installation.^{64,65} The majority of these people are employed in these industries in the District are employed by small businesses that 10 or less permanent employees apiece.⁶⁶

These sorts of green jobs can be a tangible, direct benefit of clean energy policies to LMI communities. However, for that to happen, the District Government will need to take concrete action to ensure there adequate job training, partnerships, and pathways to the middle-class. Best practices in green jobs training for LMI communities include: strong cross-sector partnerships with local, trusted community organizations; adequate funding; a well-structured, comprehensive curriculum; targeted recruitment; and wrap-around support services.⁶⁷ These are critical elements of this plan's job training recommendations, including Action CCB.13. They were also considered in the development of the District's solar jobs training program, Solar Works DC, and will be considered with other DOE jobs programs going forward.⁶⁸

⁶⁴ "U.S. Energy and Employment Report," U.S. Department of Energy, 2017. Accessed January 24, 2018. https://energy.gov/sites/prod/files/2017/01/f34/2017%20US%20Energy%20and%20Jobs%20Report%20State%20Charts%202_0.pdf

⁶⁵ "District of Columbia Solar Jobs Census 2016," The Solar Foundation, 2017. Accessed January 24, 2018. <https://www.thesolarfoundation.org/factsheet-2016-dc/>

⁶⁶ "Energy Efficiency Jobs in America" E2, 2016. https://www.e2.org/wp-content/uploads/2016/12/EnergyEfficiencyJobsInAmerica_FINAL.pdf

⁶⁷ "Making Green Work: Best Practices in Green-Collar Job Training," Ella Baker Center for Human Rights. <http://www.ellabakercenter.org/sites/default/files/downloads/making-green-work.pdf>

⁶⁸ <https://gridalternatives.org/regions/midatlantic/solar-works-dc>

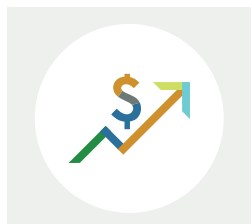
3.4 ADDRESSING EQUITY IN CLEAN ENERGY DC

3.4.1 INCORPORATING EQUITY INTO ALL ACTIONS

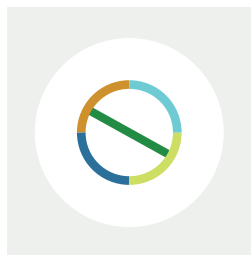
As detailed in Section 1.2, the consultant team discovered during the modeling process that placing an emphasis on GHG reductions as this plan does will prioritize actions that both reduce energy use and increase renewable energy production. This data-driven decision-making tool allows the District to focus its time and energy on actions that will deliver the greatest impact, and supports efficient resource allocation.

To produce this plan, the *Clean Energy DC* team evaluated the risks that the technical, data-driven recommended actions present to equity, followed by amendments to the proposed actions. This approach unifies a technical modelling tool that can identify actions with the greatest impact with the careful equity risk assessment, and incorporates a layer of stakeholder and expert input. The road to equity in *Clean Energy DC* begins with strategizing the exact steps required to efficiently reduce GHG emissions, then analyzing and creating amendments to ensure an equitable outcome for all residents of the District.

The *Clean Energy DC* team undertook a thorough equity analysis of each action, and developed a framework to classify the types of risks to equity found in climate action planning. The framework is structured around three major risks to equity identified in a thorough analysis of *Clean Energy DC*'s recommended actions. The team analyzed each actions for risks or nuances that would exacerbate existing inequity or create new inequity. The following are the three major risks to equity:



Increased financial burden is a potential barrier resulting from a strategy that leads to increased costs that are disproportionately carried by a District residents in the low-to-middle income (LMI) community. It is important to note that a policy may, over the long term, ultimately create a social equity benefit to marginalized groups. For example, given higher proportionate spending on utility bills for LMI families, a net-zero-energy building will reduce monthly expenses in both the short and long term.



Inaccessibility refers to barriers that arise from strategies that overlook ease of use, relevance, and ability to exploit program and action benefits, for low-income households and marginalized groups. For example, the accessibility of an online platform to promote retrofit incentives may be inaccessible to a family without access to internet or knowledge of the platform's existence. Additionally, an incentive program that targets only property owners or developers would be inaccessible to renters, including tenants of social housing developments.







Reinforcement of structural inequality refers to barriers from strategies that, if not carefully executed, could increase social equity gaps in the District (see Box 3.), or ignore historical redlining policies that still marginalize populations in the District today. If policies are not thoughtfully designed, risk exists that these structural inequalities may persist. On the other hand, these strategies also pose opportunities to create intentional policies that increase social equity in the District. For example, building-code compliance policies can be designed to be neighborhood-specific with targeted financing schemes for low-income households.





This framework focuses on risks to equity, and supports an inquiry to each action that drives the cause of the problem. This allows the consultant team and a carefully selected roundtable of local and national energy-equity experts to identify actionable solutions to each risk.

Table 4 identifies risks to equity that correspond with a proposed action, followed by the amended action with a solution. The amended actions are included in *Clean Energy DC* as the final proposed actions in the following sections. Specific additional actions targeting equity follow.

It is important to note that all proposed actions in Clean Energy DC are subject to continued revision and change as continued conversation with the District’s communities take place, and as lessons are learned through program implementation. Table 4. Amendments to Actions is an overview of the amendments to proposed actions that posed a risk to equity. These amendments are a result of a collaboration between the roundtable of energy equity experts, local stakeholder and public engagement (Section 1.4), and the *Clean Energy DC* team. This is followed by a new recommended action, EQ.1.

↓ **Table 4:** Amendments to Actions to Address Equity.

Possible Risks to Equity	Amended Action
NEW CONSTRUCTION	
NC.1 Establish a path to the phased adoption of net-zero codes between 2021 and 2026	
	<p>Amend building codes to dictate post-occupancy requirements that reflect differing unit specifications, such as each unit’s utility costs, size of unit, and type of unit.</p> <p>Prioritize new construction for low-income multifamily housing developments through financial incentives or subsidies.</p>
	<p>Consider funding new construction developments for net-zero energy affordable housing. This can be phased in, beginning with smaller projects before looking at the financial feasibility of larger projects.</p>
NC.2 Provide a net-zero energy incentive package	
 	<p>These incentive packages will prioritize developers of LMI or social housing projects.</p>

Possible Risks to Equity	Amended Action
EXISTING BUILDINGS	
EB.2 Increase DCSEU flexibility	
	Pay special attention to include LMI communities by engaging with relevant community organizations. Track the performance and results of this targeted LMI community outreach.
EB.3 Provide the incentives necessary to operate a District-wide deep energy retrofit program	
	Provide LMI communities with sustainable and equitable loans, as well as energy literacy training and energy management coaching.
	Develop and implement a specialized engagement strategy to educate and inform LMI, social, and affordable housing communities on building energy performance data.
EB.5 Implement a Building Energy Performance Standard	
	<p>Ensure owners of affordable housing developments can apply for a short-term waiver to the BEPS. In exchange for a grace period, the owners will submit a long-term plan detailing a compliance path.</p> <p>Consider offering financial incentives to building owners to support compliance, with advanced funding given to owners of affordable housing developments.</p>

Possible Risks to Equity

Amended Action

CROSS CUTTING BUILDING ACTIONS

CCB.1 Establish a Green Bank and increase other funding for energy efficiency and renewable energy projects in new and existing buildings



Explore options to include the affordable housing community in providing input to decisions made by the Green Bank, and on establishing other funding initiatives.

CCB.2 Enhance the District's Property Assessed Clean Energy financing program



The residential program will include options for unsecured financing and provide financial incentives at point of sale. Tenants of residential buildings will also have the option to finance energy-efficiency upgrades in smaller installations, rather than financing a large upgrade with multiple energy efficiency improvements.

CCB.3 Ensure code compliance in all buildings through increased investment in robust code enforcement



Help ensure impartial verification of performance standards via third-party quality assurance for code compliance. To support low-income and affordable housing developments, the District should provide design support incentives.

CCB.4 Incentivize and require submetering



This action can be particularly sensitive – and important – for affordable housing. As buildings increase in their efficiency toward net-zero energy levels of performance, developers of affordable housing must be able to provide a reduced utility allowance and proportionally increase the rent. However, the District should ensure that the net level of affordability for the tenant remains the same.

Possible Risks to Equity

Amended Action

CROSS CUTTING BUILDING ACTIONS

CCB.6 Maintain an ongoing outreach program to foster and expand awareness, education, and opportunities for collaborating around high-performance buildings



Include education and engagement on the various options for alternative energy. An important point of education is the differentiation between electricity needs and heating energy needs, the associated costs, and options for each.

CCB.12 Implement a high-performance energy media, outreach, and communications strategy



When telling this story, partner with trusted community organizations (i.e., social justice advocacy groups).

CCB.13 Create a coordinated green jobs and workforce development platform



Reach out to LMI communities in partnership with local, trusted community organizations. Promote “green job” opportunities to LMI communities.

Possible Risks to Equity

Amended Action

CLEAN AND RENEWABLE ENERGY SUPPLY

CRE.2 Provide the Standard Offer Service through aggregated power purchase agreements



The District's Standard Offer Service will provide the most competitive retail price on electricity when it is enacted, but as the price of electricity fluctuates, it may prove to be the more expensive option over time.

The District should explore options to design electricity rates for low-income customers. Low-income customers currently are exempt from paying the distribution cost included in the regular rate, approximately 25% of the average utility bill.

CRE.4 Develop a centralized solar information and commerce platform



Reach out to LMI communities in partnership with local, trusted community organizations, to help disseminate information and reach all neighborhoods and communities.

CRE.5 Continue to refine and implement the targeted solar proliferation strategy that has been launched under the Solar for All program



Include tenant advocacy groups in the design and development of the strategy. Conduct a study to determine the value proposition for tenants and property owners under different housing scenarios, and tailor outreach accordingly. Consider implementing a "Solar Coach" program that would reach rental and low income communities, to increase awareness and education on solar.

Possible Risks to Equity

Amended Action

ENERGY SYSTEM MODERNIZATION

ESM.1 Define a vision of the future grid and characterize the stages of grid modernization



Continue reaching out to stakeholders and interested citizens to increase engagement at MEDSIS town hall meetings. Expand outreach to LMI communities and tenant advocacy groups.

ESM.4 Intervene in Public Service Commission proceedings related to grid modernization



Reach out to LMI communities in partnership with local, trusted community organizations, to help disseminate information and reach all neighborhoods and communities.

ESM.11 Pursue pilot projects related to key modernization capabilities and technologies



Include tenant advocacy groups in the design and development of the strategy. Conduct a study to determine the value proposition for tenants and property owners under different housing scenarios, and tailor outreach accordingly. Consider implementing a “Solar Coach” program that would reach rental and low income communities, to increase awareness and education on solar.

Possible Risks to Equity

Amended Action

ELECTRIC VEHICLE READINESS AND ADOPTION

EV.1 Adopt an EV-ready building code



Emphasize the installation of EV charging equipment on multifamily properties can help promote EVs in high-density neighborhoods.

EV.3 Implement an EV bulk buy program



Provide income-based EV subsidies to account for LMI communities.

As Section 3.1 discussed, past government decisions have contributed to inequality. Thus, it is of utmost importance that *Clean Energy DC* addresses equity head on, and strive for equity throughout implementation and future iterations of revisions. In addition to these amendments to actions, the first action proposed in *Clean Energy DC* is an overarching strategy that will help inform the implementation process of all other actions in the subsequent chapters. This action aims to help ensure that each strategy will be undertaken in a manner that strives to support populations disproportionately affected by climate and energy issues, and to create equal access to the social benefits and opportunities posited in each action.

3.4.2 RECOMMENDED ACTIONS

In addition to adjusting other actions, there is a need for action specifically aimed at improving equity in energy planning and programs going forward. This work requires both that the District change its own approaches to engagement, and that it support community groups and residents in building capacity to engage on these issues.

EQ.1 Build capacity to plan for equity in all energy actions and programs

Action: Support capacity-building efforts to enhance the ability of local groups to engage on energy issues, and help ensure that energy planning and programs have an ongoing focus on equity.

Relevance: Historically, energy planning in the District has often not involved all populations and groups within the community. The highly technical nature of much energy and climate work often leaves certain communities out of the process. However, energy issues affect everyone in the District. Moreover, many socially and financially vulnerable groups will especially feel the resulting impacts—positive or negative—on energy prices and climate vulnerability. While DOEE has sought to identify and address equity concerns with this plan, and to engage and involve local groups and residents, this is just the start of this work. Through these conversations DOEE have learned that additional training and capacity building is often needed for residents to have in-depth conversations about energy planning. This work is sufficiently important to justify its own action in the plan.

Details: DOEE has begun several innovative efforts to start building capacity with local groups in the District, supported by grant funding.

As a place-based pilot project, the District has established an Equity Advisory Group (EAG) of ten community residents from the neighborhoods around the Watts Branch stream, to guide planning and implementation of the Clean Energy DC and Climate Ready DC plans. The District formed the first EAG in a specific neighborhood impacted by environmental issues. While energy is a District-wide issue, working with a place-based group can result in deeper, more meaningful conversations and relationships.

Through community interviews, DOEE has learned that residents are more inclined to own these efforts if there are some early success demonstrated in their communities. This directly aligned with other efforts to leverage climate resiliency initiatives and the associated funding, such as a U.S. Army Corps of Engineers flood-risk study that will provide the sort of building-level detail not usually available for neighborhood-based planning. Grant funding has increased the capacity of the EAG members by addressing barriers to convene community meetings to include food, transportation, and childcare and providing training and technical support to both residents and government staff. The EAG will guide the development of community-driven climate-resilience and clean energy strategies that combine climate mitigation and adaptation with express considerations of equity through power sharing and co-equal development with the project team and government partners.

Additionally, DOEE is working with a set of community partners to begin determining if or how the District can get 100% of its electricity from renewable sources by 2050, and how to ensure that benefits are shared equally amongst all populations in the District, and that at-risk populations do not carry the burden disproportionately. The District has grant funding to begin the planning process. The first year of the project will focus on understanding what

an equitable, renewable District looks like to yet to be determined neighborhoods. Over the summer of 2018, two largescale community meetings will be held in different District neighborhoods to enable community members to share their views on equity and renewable energy. This information will be used as the foundation for a future planning process. DOEE also plans to partner with the Office of Peoples' Counsel (OPC) to aid in public engagement and capacity building efforts focused on energy issues specifically.

In engaging with the community on energy policy and building capacity, several key elements of communication must be considered. The following key points emerged directly out of the community engagement done by DOEE and the Clean Energy DC team in 2017, along with the results of local focus groups conducted for Sustainable DC 2.0.

- Diversity in language and culture within organizations is important, as well as representation or engagement from all communities – multicultural and multilingual materials need to be created and circulated by the DOEE. The District should go beyond what is required by the Language Access Act to proactively expand the set of materials and resources translated, the language mix of translations, the physical representation of people, and the connection to hyperlocal areas of the District that may be more relevant than the Wards or ANCs. Engagement should be rooted in communities, be linked to impact specific needs, and be sensitive to cultural practices.
- Place and personal connections matter – where engagement activities are conducted is always an important consideration, but simply checking a box by going to a location is not sufficient; DOEE should invest in building and maintaining long-term relationships. The District should intentionally prioritize communities that have had a disproportional impact by the lack of education and awareness spread to them.
- While electronic communications may seem easy and cheap, the “digital divide” remains a major impediment to accessing information in some communities and populations, so other communication methods must always be used as well.
- Find a way to relate each action to other issues. The District Government and its partners must ensure that they communicate and discuss how do these actions align with and connect to other major challenges and initiatives in the District. Issues need to be kept relevant to ensure buy-in, and there needs to be a process to ensure that these communities are kept in the conversation as plans and programs are updated or changed.
- As part of agency community engagement, DOEE should consider a sustainability public education and marketing campaign to educate and inform local businesses and residents of the city’s sustainability priorities, activities, and resources, as well as the impact and value to the business community and residents.

Next Steps

- 1 In 2018, create a guide on how to launch and administer equity advisory groups during agency plan development and implementation. This guide should be co-created with the community in the Watts Branch pilot project and clear guidance on how to replicate the advisory group in the future.
- 2 In 2018, hold two neighborhood meetings on 100% renewable energy planning and equity to allow the community to help define success from the beginning of the project. These meetings should be held in vulnerable communities particularly impacted by energy planning but who have traditionally been underrepresented in the planning process.
- 3 Apply the experience and lessons learned from the two projects above to current and future planning efforts such as Sustainable DC 2.0 and the next update of the Clean Energy DC plan.





BUILDINGS

4 BUILDINGS

In this chapter, recommendations are provided in three interrelated sections: **New Construction** (section 4.1), **Existing Buildings** (section 4.2), and **Cross-Cutting Building Actions** (section 4.3) that apply to both new and existing buildings. At the end of the chapter, each set of recommendations is summarized by an individual roadmap that can be used by the District to guide their implementation of the first five years of *Clean Energy DC*, as well as future actions through 2032.

4.1 NEW CONSTRUCTION

4.1.1 POLICY AND TARGETS OVERVIEW

Rapid reductions in carbon emissions are both necessary and feasible in the District's new construction sector. New designs and technologies can deliver superior occupant services while using substantially less energy than a building built to typical North American building codes.⁶⁹ The construction of these high-performance buildings will be critical to ensuring high-performance of homes, workplaces, and other buildings, for the duration of their useful life, which can extend several decades.

This section presents several recommendations to promote, construct, and support high-performance buildings across the District. These actions are targeted to single family homes, large and small multifamily buildings, offices, government buildings, and most other building types in the District.

While the number of high-performance buildings in the District is currently small, awareness of their benefits is spreading. Developers are increasingly aware of, and drawn to, energy efficiency, renewable energy, improved thermal comfort and daylighting, higher worker productivity, and more resilient performance during power outages. However, in the absence of regulatory requirements, these things tend to remain on the "nice to have" list.^{70,71}

By upgrading building codes, providing financial support, and offering educational and training opportunities for the design and construction industries, the District Government can transform its built environment for low-carbon resilience.

⁶⁹ Throughout this document, "codes" refers to "energy, building, and construction codes."

⁷⁰ Judith Heervagen, *Impact of Workplace Daylight Exposure on Sleep, Physical Activity, and Quality of Life*,

⁷¹ Alex Wilson, *Resilient Design: Smarter Building for a Turbulent Future*, Environmental Building News, March 2012.

4.1.1.1 HIGH-PERFORMANCE BUILDINGS CHARACTERISTICS

Across the United States, the number of high-performance buildings is growing. Nationwide, 39 buildings have achieved the International Living Future Institute's (ILFI) Net-Zero Energy Building certification—including a six-story Class A office building and a production townhome community. Another 350 buildings are seeking the same level of performance and are now in various stages of development.⁷² The New Buildings Institute's (NBI) *Getting to Zero* database includes approximately 140 net-zero or net-zero ready commercial and multifamily buildings, while the Net-zero Energy Coalition has documented several thousand potential, and 21 verified, net-zero energy homes.^{73,74}

These high-performance buildings share a consistent set of design and technological characteristics,⁷⁵ including:

- High-quality building envelopes with average insulation values twice those typically required by North American building codes, as well as detailed performance-tested air barriers.
- High-performance windows that reduce cooling demand in the summer and minimize heat loss in the winter.
- Partially passive heating and ventilation systems that reduce the need to use energy-intensive mechanicals systems.
- Heat pump-based heating and cooling systems that offer energy-efficient alternatives to conventional heating and cooling systems.
- Hydronic distribution systems for heating and cooling.
- Heat recovery systems that minimize heat loss through ventilation.
- Daylighting strategies that reduce the need for electric lighting.
- Energy efficient LED lighting.
- Variable speed drives and pumps that vary ventilation and heating/cooling distribution speeds to provide optimal levels of heating, cooling and ventilation.
- Active monitoring and engagement with user loads.
- Easily accessible, transparent energy use data.
- Active attention to actual building energy usage on the part of building managers.

While these technologies and designs are generally not the norm in new construction, they are well tested and understood. What is most innovative about high-performance buildings is that they consolidate and integrated the full array of technologies and strategies under one roof.

⁷² ILFI website, data obtained May 25, 2016.

⁷³ <http://newbuildings.org/resource/getting-to-zero-database/>

⁷⁴ <http://netzeroenergycoalition.com/zero-energy-case-studies/>

⁷⁵ Lijiequist, B., 2016, *The Power of Zero, Learning from the World's Leading Net-zero Energy Buildings*.

4.1.1.2 MARKET DEVELOPMENT AND ADOPTION

While the number of these high-performance buildings is growing, several barriers to their widespread adoption still exist, both within the District and elsewhere in the U.S. It is often assumed that cost is the primary driver towards market acceptance of technology change within the built environment. However, the reality is that many factors influence the adoption of new, innovative models of building design and construction. Some of these factors include the following.

Market uptake of new, but proven, technology: Many high-performance building technologies have moved beyond the prototype stage and have been certified by the relevant federal Occupational Safety and Health Administration's Nationally Recognized Testing Laboratory. Technologies and systems such as those listed above are widely available in the marketplace. However, they have not yet become a standard part of the building and construction industry in many cities.

Technical know-how by building specialists: Another reason for low uptake rates is the lack of familiarity with newer building technologies among engineers and architects. As with other major cities working to improve building energy performance, there are a handful of firms and contractors in the District with direct experience in these advanced buildings, which enables their construction locally. However, many firms have little experience with high-performance building technologies.

Knowledge and understanding: As in the case of building specialists, there is a dearth of knowledge about high-performance buildings among building industry members, such as property managers, building owners, and developers. As such, while developers may be interested in pursuing high-performance projects, a lack of understanding of, or comfort with, the options available may hinder uptake.

Delays in the spread of innovation: The delay between the introduction of an innovative technology and its widespread adoption by the mass market typically lasts several years. This is the classic innovation diffusion pattern, in which a small number of early adopters accept an innovation long before it becomes popular. However, an innovation can more quickly move into the mainstream with effective communication channels. Effective marketing can strengthen demand for high-performance buildings. This demand can, in turn, create a competitive environment, further accelerating innovation and reducing costs.

Demonstration buildings: The ability to see and experience a local, successful example of a high-performance building greatly accelerates the spread of building innovations and drives acceptance. Of the hundreds of examples of high-performance buildings that can be found across the country, a few are in the District. For example, Dunbar High School boasts a solar array, the District's largest ground-source heat pump, and the highest score achieved in the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) for Schools-NC certification program to date.⁷⁶ The construction of similar buildings will help increase the visibility and uptake of high-performance buildings.

Collaboration: The history of innovation is filled with communities of people evolving innovation together. The District currently has an assortment of high-performance building leaders, but bringing them together in a more cohesive way would greatly accelerate the uptake of high-performance building technologies.

⁷⁶ U.S. Green Building Council, 2015, <http://www.usgbc.org/articles/reaching-new-heights-dunbar-highest-scoring-leed-schools-nc-project-date>

Cost: At the end of the day, costs matter. The construction cost premium of a high-performance building can pencil out 3% to 10% above that of a conventional building built to the minimum energy efficiency standards of code.⁷⁷ A small study conducted within the District has indicated that the cost premium for highly energy efficient buildings is approximately 1% to 12%, depending on building type, with a return on investment ranging from 5% to 12%.⁷⁸ Achieving net-zero energy performance increases the estimated cost premium to 5% to 19%, with a return on investment of up to nearly 38%, depending on the use of available tax and renewable energy certificates.

However, these cost differentials are largely the product of a pricing system based on customized, non-standard fabrication and design. As North American and European governments at all levels increasingly shift toward requiring net-zero ready and Passive House levels of performance, the materials needed for high-performance buildings are growing more common, and costs will decline accordingly. Meanwhile, as industry experience increases, the cost premium associated with design and construction also declines.

4.1.1.3 DISTRICT ACTION

The recommendations offered below seek to address the limitations identified above. The District has already made several moves to improve the energy performance of its buildings through various changes to its laws and building codes.

The history of green-building policy in the District began with the *DC Green Building Act* of 2006, which requires LEED certification of all new and major renovations of commercial private buildings 50,000 square feet and larger, and all public or publically financed commercial projects and multifamily buildings larger than 10,000 square feet. In 2014, the District adopted one of the country's greenest building codes by approving the 2013 *DC Green Construction Code*, based on the 2012 edition of the *International Green Construction Code*, and the 2013 *DC Energy Conservation Code*, based on the 2012 edition of the *International Energy Conservation Code*. DCRA reviews all projects for energy code compliance. The *DC Green Construction Code* requirements apply to all commercial new construction and renovation projects 10,000 square feet and larger, and all residential projects 10,000 square feet and larger and four stories or higher, that do not fall under the jurisdiction of the *Green Building Act*. However, much remains to be done to improve the energy efficiency of new buildings, and transition the District's buildings to high-performance, low-carbon standards.

⁷⁷ The Power of Zero: Cost Study, 2014, <http://www.integralgroup.com/wp-content/uploads/2013/09/Power-of-Zero.pdf>

⁷⁸ Net-zero and Living Building Challenge Financial Study: A Cost Comparison Report for Buildings in the District of Columbia, 2013, http://doee.dc.gov/sites/default/files/dc/sites/ddoe/service_content/attachments/20140411_Net%20%20Zero%20and%20Living%20Building%20Challenge%20Study_FINAL.pdf

4.1.2 RECOMMENDED ACTIONS

4.1.2.1 UPDATE BUILDING AND ENERGY CODES

NC.1 Establish a path to the phased adoption of net-zero codes between 2021 and 2026

Action: Use the 2018 and 2021 code updates to establish a pathway toward net-zero energy performance in all residential and commercial buildings over the next 10 years, starting in 2021 with the construction of new single-family and small multifamily buildings.

Relevance: Building codes are the single most powerful tool that cities have at their disposal to require higher levels of building performance. In general, codes tend to increase in stringency using small percentage improvements that occur at regular intervals. For example, several cities and states across the country have adopted ASHRAE's 90.1 building standard as a basis for their energy codes, and it is updated every three years. ASHRAE also recently created the ASHRAE Standard 189.1-2014, which supplements 90.1 with a higher performance green building standard. Provisions in this code offer an excellent resource for more aggressive energy improvements.

If the District is to achieve its emission-reduction targets, it will need to make immediately and more aggressively update its building code. It will need to push requirements toward net-zero energy performance to meet its energy and greenhouse gas (GHG) emissions targets and maintain its position on the leading edge of green building code development.

Code authorities regularly release updates, and the District has a history of heavily amending and strengthening national model codes in creating its own building code. The next update of the latest code cycle is expected to occur in 2018, with the proposed new code scheduled to be released for public comment in early 2018. Another code amendment is in the works for 2021. These amendments offer key near-term opportunities for the District to move building requirements toward net-zero levels of performance.

Building code updates also afford the District an opportunity to improve building resilience to climate change (in support of Climate Ready DC) and support grid modernization (as discussed in Section 5.2). Net-zero building strategies can also overlap with the push for more resilient buildings, such as on-site electricity generation to serve all building energy needs. This helps shelter building occupants from grid outages and lower daily energy requirements, allowing on-site energy generation and storage to serve more occupant needs (e.g., space heating, water heating, refrigeration) over a longer period.

Details: It may be premature for the District to implement net-zero energy levels of performance for all building types with the 2018 code, but the District Government should plan to build a foundation for and pathway toward a complete set of net-zero building codes by 2026, at the latest.

As discussed in the previous section, net-zero ready buildings currently carry higher upfront cost than standard code-compliant buildings, but reduce annual energy, and sometimes maintenance, costs. A 2013 study on the District identified cost premiums associated with net-zero to be between 1% to 6% for office buildings, and 2% to 7% for multifamily buildings,⁷⁹

⁷⁹ Net Zero and Living Building Challenge Financial Study: A Cost Comparison Report for Buildings in the District of Columbia, 2013, http://doee.dc.gov/sites/default/files/dc/sites/ddoe/service_content/attachments/20140411_Net%20Zero%20and%20Living%20Building%20Challenge%20Study_FINAL.pdf

while a 2015 study from Vermont found a 12% increase in the cost of single family dwellings.⁸⁰ A 2017 study that analyzed net-zero ready buildings in the same climate zone as the District's found that net-zero ready office, retail, and larger multifamily (high-rise and low-rise) buildings can currently all be constructed with a cost premium under 3%, while premiums for smaller multifamily buildings can range from 3 to 6%, depending on the building style.⁸¹ The same study found that premiums for single family dwellings were found to range from 3% to 4% for medium and large-sized homes, and up to 14% for small homes.

Governments and other organizations will continue to conduct these analyses, but the cost premiums are expected to continue to decline, for the reasons discussed in the previous section. In pursuing a path to net-zero ready building codes, the District should continue to review these kinds of cost analysis to inform the design and execution of any supporting initiatives, such as the provision of education materials and events, training seminars, best practice guides, incentives, and prescriptive requirements.

While the District Government has not yet fully determined how to qualify a building as net zero, the development of Appendix Z is a first step towards codifying such buildings in the future. Appendix Z is the first voluntary, performance-based code compliance pathway for buildings in North America, and has been included into the 2018 code. It defines a net-zero energy building as a highly energy efficient building that produces on-site or procures, through the construction of new renewable energy generation, enough energy to meet or exceed the annual energy consumption of its operations.

The Appendix establishes minimum building performance requirements for overall energy use intensity, thermal energy performance, and airtightness. To achieve net zero, a building must be made as energy efficient as possible before specifying renewable energy equipment that would supply it. It also outlines requirements concerning appropriate type of renewable energy generation, as well as specific stipulations for energy metering and building commissioning.

Recommendations for the 2018 Update: For the current code update, the District should implement an increase in energy code requirements typical of a three-year cycle. However, these should be joined by tactical requirements that take advantage of current incentives and support more significant changes as early as 2020. Specific areas the District should consider adopting:

- A requirement for continuous exterior insulation. This requirement should be coupled with advanced fresh-air ventilation requirements to ensure good indoor air quality.
- A requirement for windows with U values equivalent to the top 25% in class, based on an exploration of the selection of windows currently available in the DC marketplace.
- An alternate compliance path for high-performance buildings, such as net-zero, Passive House, or the Living Building Challenge. Such a code should also be used as a basis for awarding financial and permitting incentives. This is accomplished through the inclusion of Appendix Z (discussed above), which was included in the proposed 2018 code update developed during the development of this Plan. A similar path for single-family net-zero energy green homes should also be developed.

⁸⁰ Efficiency Vermont. "Net Zero Energy Feasibility Study Full Report." January 2015

⁸¹ British Columbia Energy Step Code: 2017 Metrics Research, <https://www.bchousing.org/research-centre/library/residential-design-construction/energy-step-code-2017-full-report>

The District Government should also explore specific requirements for commercial and residential buildings. For *commercial buildings*, it should:

- Adopt ASHRAE Standard 90.1-2013 and chapter seven of ASHRAE 189.1-2014
- Adopt a commercial air leakage performance testing requirement, like the requirement for residential buildings in the 2013 code update.
- Sub-metering of major systems, including plug loads (pending feasibility and value analysis).
- Sub-metering of tenant spaces.

The District Government should consider clarifying zoning regulations pertaining to the use of solar panels, including classifying solar panels differently than other rooftop mechanical equipment to allow for reduced setbacks and thus more coverage.

For *residential buildings*, the District Government should:

- Adopt a requirement for the use of mini-split ductless heat pumps as the primary heating source in residential buildings using electric resistance heating above 2 kW of installed capacity, as has been required by the State of Washington.
- Create a Green Construction Code for single-family and small multifamily buildings (under four stories tall, or 10,000 square feet) that include measures like those included in the other existing District green codes.
- Offer alternative compliance paths for third-party standard pathways, such as LEED for Homes, Enterprise Green Communities, Passive House, and Living Building Challenge.⁸² and,
- Continue to mandate air performance sealing, and add any supplemental requirements determined appropriate based on experience implementing the 2012 code.

Recommendations for the 2021 Update: For the next code cycle, the District Government should push a much stronger update that drives all buildings toward net-zero energy performance by 2026 at the very latest.

For the *DC Residential Energy Code (single-family and small multifamily residential buildings (<10,000 square feet))*, the District Government should adopt a net-zero energy code for new construction in 2021, and require all substantial renovations to be net-zero by 2026 at the very latest.⁸³

For *commercial and large multifamily buildings*, the 2021 code update should mandate a series of prescriptive measures that begin to shift the sector toward net-zero energy performance and net-zero energy codes for all buildings. While this can be adopted as late as 2026, the District Government should investigate the feasibility of moving to a net-zero code even earlier. The 2021 code update should include (but not be limited to) the following prescriptive measures:

- Minimum Insulation: R-40 walls, R-60 roof
- Minimum Windows: U=0.22
- Minimum air leakage rate: 1.0 ACH @ 50 Pascals
- Ventilation: rate and locations per ASHRAE using heat recovery and dedicated outdoor air systems, solar electric pre-heat

⁸² Based on recommendations from DOE's Single Family and Small Multifamily Working Group.

⁸³ Based on recommendations from DOE's Single Family and Small Multifamily Working Group.

- Heating and cooling: reverse cycle chillers, high-performance air source heat pumps, with VRF or hydronic distribution, with carbon dioxide (CO₂) mandated as compression gas
- Lighting density: 0.3 W/ft²
- A minimum level of daylighting for all occupied spaces
- Occupant and operator energy monitoring system and reduction strategy
- Minimum appliance standard: best in class ENERGY STAR®
- Solar panels throughout all flat roof areas, except those needed for skylights, vents, HVAC equipment, and other sustainable improvements such as green roofs ⁸⁴
- Hot water: heat pump-based system

In addition to these performance requirements, the District should also include minimum requirements for post-occupancy performance, including minimum energy use intensity (EUI) performance requirements appropriate for a given building and unit type and size. This will allow the District Government to regulate the occupancy phase and ensure all loads are addressed while enabling the separation of responsibility between developer and occupant/operator. The District may wish to use the ILFI's Living Building Challenge (LBC) or Net-zero Energy Building (NZEB) certification, which requires a third-party auditor to certify net-zero energy performance. This will help protect tenants in multifamily buildings from disproportionately bearing cost premiums associated with new building codes. New construction for low-income multifamily housing developments should be prioritized through financial incentives or subsidies and requirements for tax credit award. This can be phased in, beginning with smaller projects before looking at the feasibility of funding larger projects.

Finally, depending on the stringency of the 2021 code requirements, the District should adjust its code update cycle to pause code updates for five years following the adoption of net-zero code requirements, waiting until 2026 for the next code update. This will improve industry palatability as it will reduce the disruption associated with shorter code cycles.

Next Steps

- 1 Fully adopt and codify the new 2018 energy code in 2018.
- 2 In 2018, analyze the feasibility of moving toward net-zero single-family and small multifamily residential codes during the next code update.
- 3 In 2018 and 2019, engage with stakeholders and determine a pathway to net-zero codes across all buildings by 2026 at the very latest, with an objective to adopt net-zero codes earlier.
- 4 In 2019, the Construction Code Coordinating Board should begin work on developing the 2021 energy and green construction codes.

⁸⁴ HVAC is heating, ventilation, and air conditioning.

4.1.2.2 UPDATE BUILDING AND ENERGY CODES

NC.2 Provide a net-zero energy incentive package

Action: Offer a major incentive package that drives a steady market shift toward the construction of net-zero energy buildings.⁸⁵

Relevance: Increasing the proportion of high efficiency, net-zero energy buildings will be critical to achieving deep GHG and energy-use reductions in the buildings sector. To shift the market in this way, the District Government must provide an attractive package of incentives that drive different choices and behaviors. If effectively designed and implemented, these incentives can drive a steady shift over the next few years toward the types of buildings the District Government will soon need to require. By promoting high-performance buildings through incentives in the short term, the District will provide an aspirational symbol for developers, building owners, designers, and contractors.

Details: If it is to capture the attention of mainstream developers, the District Government will need to offer substantial incentives—especially during periods of fast-paced construction. An effective incentive package will comprise the components listed below.⁸⁶ Consider rolling out these programs and incentives for single-family and multifamily buildings first, in line with the phasing-in of net-zero energy building codes. Also, when assembling these incentive packages, the District Government should look for opportunities to prioritize developers of low-to-middle income and social housing projects.

Property Tax Abatements: First and most importantly, the District Government should create a pilot program to provide property-tax abatements for buildings that meet net-zero energy standards. A tax abatement occurs when a government reduces a property's tax rate in return for meeting certain criteria. These tax abatements should be based on the actual building energy performance, rather than the performance it was initially designed to achieve. Tax abatements should cover up to 75% of any cost premium associated with a building operating at the prescribed net-zero energy performance, not including the cost of renewables (which are already heavily incentivized).

To create an initial cadre of net-zero energy -buildings, the District Government should initially limit the program to 20 projects. After this initial phase, the District Government should evaluate the effectiveness of the program and adjust the level of incentives provided accordingly. This program's cost will depend on the types and sizes of buildings included, as well as their performance (e.g., net-zero energy, net-zero water, Living Building Challenge).

With 75% abatement, a single-family dwelling would cost the District Government \$400 to \$800 per year in lost property tax revenues, small and large multifamily buildings would cost \$8,000 to \$150,000 per year, and small to large commercial buildings would cost between \$15,000 and \$105,000.⁸⁷ Assuming a variety of building types and performance levels, a preliminary estimate suggests the program could cost the District Government around \$15 million in foregone taxes. After the tax abatements expire, however, tax revenue to the District will increase. The increased property, deed transfer, and recordation tax revenue also pencil out around \$15 million (assuming a 3% discount rate), effectively making the program cost-neutral to the District Government over time.

⁸⁵ *Greening the District of Columbia: Incentives and Policies to Achieve Deep Green Building Construction and Renovations*, commissioned by DOE and completed by Capital E, 2016.

⁸⁶ *Ibid*

⁸⁷ *Greening the District of Columbia: Incentives and Policies to Achieve Deep Green Building Construction and Renovations*

Accelerated Permitting: The District Government should also provide an accelerated permitting pathway for net-zero energy projects. This pathway should simplify the permitting process and reduce DOEE and DCRA permitting time. The Office of Zoning should also grant net-zero energy projects a streamlined hearing process and reduced/eliminated fees from the Office of Zoning. This program will require support from upper-level leadership and dedicated staff. The District Government should consider a front-of-queue system to ensure accountable and verifiable expedited processing. The cost of staffing this incentive and serving 20 buildings over 4 years is estimated to be under \$60,000.⁸⁸

Reduced permit fees: To encourage early adopters of net-zero buildings the District Government should reduce or waive permit fees for net-zero energy projects. The permit fees should be discounted or waived by DCRA once the green plans reviewer has verified the design meets a code official approved net-zero energy standard. The Permit Schedule of Fees (12 DCMR Schedule K) specifies the cost of permits; New construction and alterations are charged differently based on size.⁸⁹

Floor Area Ratio Increases: The District Government should grant floor area ratio (FAR) increases for buildings that target net-zero energy standards. FAR is the ratio of a building's total floor area (gross floor area) to the size of the piece of land upon which it is built, so zoning limits on FAR are in effect limits on building height and massing. Many jurisdictions across the country grant FAR bonuses in return for green features. However, thanks to the *Federal Height Act*, many District buildings are already maxed out on floor area ratio and unable to go higher. Accordingly, this incentive will have limited applicability. In many parts of the District, the zoning code limits FAR and building height to levels far below the *Height Act* limits; in these areas, a FAR incentive could be very helpful. This is expected to cost very little financially, but the District Government would need to consider the opportunity cost of implementing this incentive, specifically whether it limits the ability to pursue other energy and/or sustainability-focused zoning policies.

Green Area Ratio Increases: Fourth, the District Government should utilize the Green Area Ratio (GAR) program to incentivize on-site renewable energy needed for net-zero energy buildings. GAR is an innovative environmental sustainability zoning regulation that sets standards for landscape and site design to help reduce stormwater runoff, improve air quality, and keep the District cooler.⁹⁰ The District should consider increasing the (GAR) multiplier for solar panels to incentivize an increase in solar panel installations, as well as considering an increase in the overall GAR requirement in all zones.

PACE and Green Bank Financing: As discussed in the Cross-Cutting Buildings section, the District should continue to promote the Property Assessed Clean Energy (PACE) financing program for commercial and multifamily buildings to help finance net-zero energy improvements for new construction projects (See Action EB.5 for more). As part of adjusting and expanding PACE, the program should amend project underwriting criteria to provide accelerated approval for building improvements essential to achieving net-zero energy performance levels. This should be independent of near-term financial payback calculations, so long as they advance this broader public purpose. This underwriting incentive would provide project developers with a valuable program enhancement by offering guaranteed access to upfront capital to finance any additional marginal costs associated with these upgrades. If the District creates a Green Bank (as recommended in Action CCB.1), the Green Bank should explore other incentives for NZE buildings.

⁸⁸ Ibid.

⁸⁹ https://dcra.dc.gov/sites/default/files/dc/sites/dcra/publication/attachments/BldgPermit_Feesupdate_0.pdf

⁹⁰ <http://doee.dc.gov/GAR>

While the incentives above may apply more specifically to commercial and large multifamily buildings, the District Government can offer similar incentives to single-family and small multifamily buildings under 10,000 square feet. These should include expedited permitting and waived fees for buildings that meet designated performance requirements or certifications (e.g., a net-zero energy certification).⁹¹

Next Steps

- 1 In 2018, design the structural and regulatory incentives, such as accelerated permitting pathways, and floor area ratio and green area ratio bonuses, and implement them in conjunction with the updated construction and zoning codes. Begin with single family and small multifamily buildings.
- 2 Develop policy initiatives to allow tax abatements or other financial incentives for deep green retrofit projects beginning once the updated codes are in place.
- 3 Starting in 2020, explore financial incentives and funding for net-zero energy affordable housing developments.

4.1.2.3 LEADERSHIP AND CATALYZING CHANGE

NC.3 Issue a net-zero energy innovation request to the federal government and regional governments

Action: Lobby the federal government and other regional governments to adopt the same level of building energy performance as the District Government.

Relevance: The District Government has no jurisdiction over federal government buildings in the District, making it impossible to require them to achieve any specific level of performance. However, the District has a unique opportunity to influence the federal government because of both their co-location and the special relationship between the two jurisdictions. While District Government legislation is subject to Congressional approval, the relationship can be two-way, allowing ideas and inspiration to move from the District to the federal government and vice-versa. Moreover, alignment between the District and other regional governments on high performance building will benefit the entire region and reduce costs.

Furthermore, Executive Orders have put the federal government on track to require net-zero levels of performance in all newly constructed buildings, where feasible, during the next decade.^{92,93} The United States Department of Energy (DOE) has also taken a leadership role by supporting the development of high-performance buildings. As such, there is an opportunity for the District to encourage the federal government to construct new buildings that meet a net-zero energy level of performance. Especially where they are particularly prominent, these high-performance buildings will help to accelerate similar development within the District while providing examples for the rest of the country.

⁹¹ Based on recommendations from DOE's Single Family and Small Multifamily Working Group.

⁹² Executive Order 13693 -- Planning for Federal Sustainability in the Next Decade, 2015, <https://www.whitehouse.gov/the-press-office/2015/03/19/executive-order-planning-federal-sustainability-next-decade>

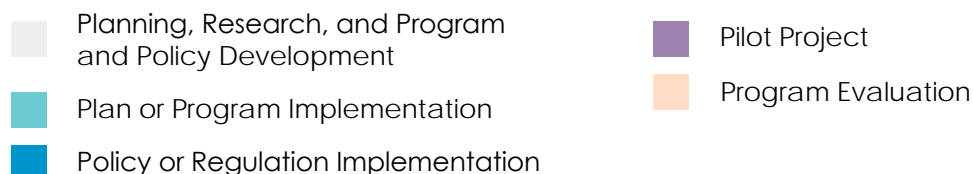
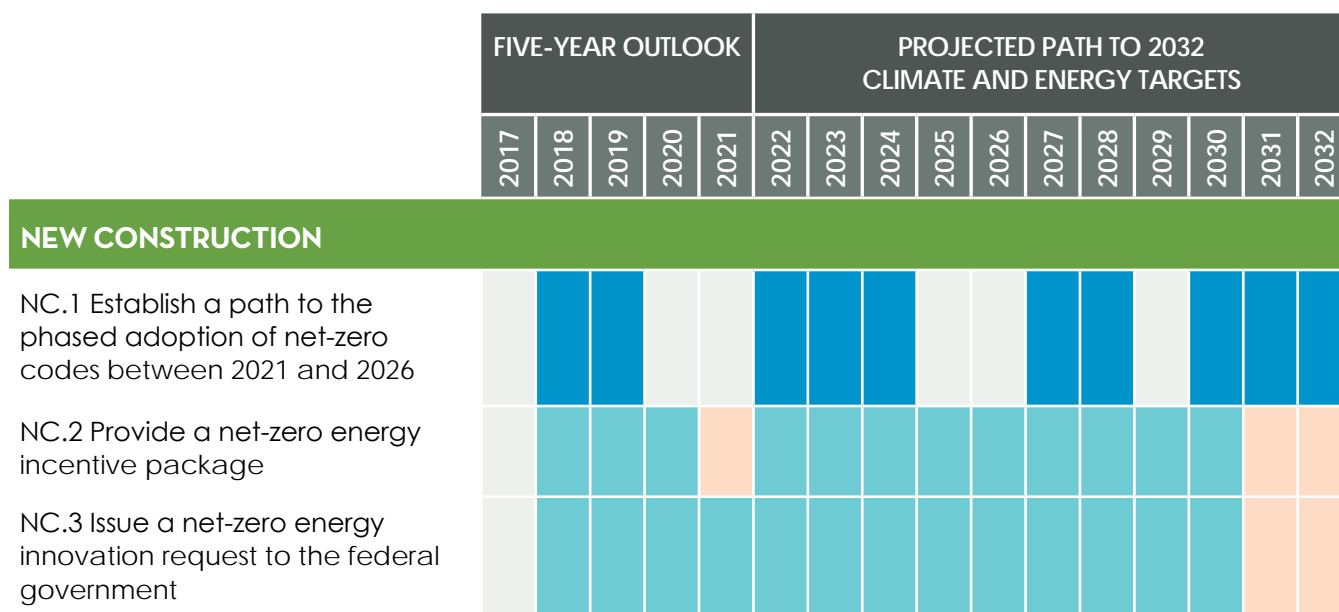
⁹³ Executive Order 13514 -- Focused on Federal Leadership in Environmental, Energy, and Economic Performance, 2009, <https://www.fedcenter.gov/programs/eo13514>

Details: To encourage the federal government to achieve the same level of energy performance required by the District Government, the Council of the District of Columbia should issue a request by resolution that would challenge both Federal and District government agencies to build to higher standards. Testimony to Congressional committees will help educate and raise awareness among the industry and broader public, and can help to push the discourse forward. In all of these efforts, the District Government should focus on the potential to drive a healthy, innovative economy, while creating well-paying, middle-class green collar jobs. The District Government should meet the same or higher standards as it is challenging others to meet. A detailed discussion of how the District Government can lead by example in building energy efficiency is found in Actions EB.9 and EB.10.

Next Steps

- 1 In 2018, adopt a resolution to challenge the federal government and other regional governments to adopt the highest performance standards for government buildings, and to meet those standards for District Government buildings as well.

4.1.3 NEW CONSTRUCTION ROADMAP



4.2 EXISTING BUILDINGS

4.2.1 POLICY AND TARGETS OVERVIEW

Existing buildings consume more energy in the United States than any other sector, accounting for approximately 40 quadrillion BTUs of energy, or over 41% of all the energy used in the country.⁹⁴

The District's dense urban makeup means that buildings account for an even higher portion of energy use and emissions. In 2014, District buildings consumed approximately 15 million MMBtu of on-site energy, 70% of which was electricity use.⁹⁵ Approximately 74% of GHG emissions in the District result from the operation of these buildings, the majority of which are non-residential.⁹⁶ The District will only meet its energy and emissions climate targets if it pursues actions and programs that target existing buildings—especially commercial buildings.⁹⁷ However, reductions in energy use and emissions from residential buildings are also integral to reaching the District's energy and emissions targets, and the private and public sectors will have to work together to make gains.

The District has already taken significant steps to improve building energy performance. It has taken action on residential and commercial buildings through the District of Columbia Sustainable Energy Utility, an arms-length organization. Concurrently, the Department of General Services and District of Columbia Housing Authority have focused on government building performance.

4.2.1.1 IMPROVING THE PERFORMANCE OF PRIVATELY-OWNED BUILDINGS

The District of Columbia Sustainable Energy Utility (the DCSEU) is the District Government's third-party demand side management (DSM) program administrator, overseeing a wide variety of energy efficiency programs and incentives. Established in 2012, it is currently operated by Vermont Energy Investment Corporation (VEIC) under contract to DOEE.

The DCSEU helps residents, institutions, and businesses reduce energy costs through approximately two dozen programs that are largely funded by a fee levied on ratepayers. It separates its services into residential buildings, low-income multifamily buildings, commercial and institutional buildings, and renewable energy generation. The wide range of services include discounts on energy efficient products (e.g., LED lighting, ENERGY STAR appliances) and financing solar PV system installations.

The contract with the DCSEU establishes a set of annual minimum and maximum targets. The targets focus on reducing electricity consumption, peak electricity demand, natural gas consumption, and energy costs; increasing local renewable energy capacity; and, creating green jobs, among others. In addition to these overarching targets, the DCSEU is mandated to focus 20% of its resources on low-income communities. In the Fiscal Year 2017, it invested \$8.3 million in affordable housing projects, foodbanks, shelters, and other buildings serving low-income communities.

⁹⁴ This is based on source energy use numbers from the U.S. Department of Energy, Energy Information Administration, <http://www.eia.gov/tools/faqs/faq.cfm?id=86&t=1>.

⁹⁵ The final benchmarking dataset incorporate herein refers to the NYU CUSP dataset of 2014 "cleansed" data.

⁹⁶ Green Building Report for the District of Columbia, 2012, http://doee.DCgov/sites/default/files/dc/sites/ddoe/publication/attachments/20140113_Green%20Building%20Report%202012_FINAL.pdf, p.9.

⁹⁷ Sustainable DC Plan, 2012

Since Fiscal Year 2014, each year the DCSEU has continued to meet or exceed the minimum benchmark savings in energy use and cost.⁹⁸ It introduced maximum benchmarks to the contract for 2016, and in 2017 it hit all minimum benchmarks⁹⁹ and most maximum benchmarks. The majority of savings originated in the commercial sector (80-90%), with savings in the residential sector more difficult to achieve due to the existing building interventions being less cost-effective than in the commercial sector.¹⁰⁰

The continued performance improvement—coupled with this Plan's recommended additional flexibility and funding—suggest the District is well positioned to achieve the existing building energy and emissions reductions necessary to hit its 2032 targets.

4.2.1.2 PUBLIC SECTOR LEADERSHIP

Two District agencies will be important in maintaining and furthering its leadership on climate and energy through *Clean Energy DC*. The District's Department of General Services (DGS), which manages the District's real estate portfolio, actively works to lower energy use and GHG emissions. DGS already tracks and publishes 15-minute interval data for all government buildings via the BuildSmartDC program.¹⁰¹ This demonstrates transparency and accountability for government building performance and underscores both the importance and value of managing building performance in real-time.¹⁰² DGS will need to continue leading by example through earlier and farther-reaching action to shift towards a portfolio of buildings that better support a low-carbon future.

The District of Columbia Housing Authority (DCHA) will prove another *Clean Energy DC* catalyst. It provides quality affordable housing to extremely-low through moderate-income households, fosters sustainable communities, and cultivates opportunities for residents to improve their lives.¹⁰³ Similar to DGS, early and ongoing support by DCHA to advance *Clean Energy DC*'s building actions will send important signals to the local market and ensure that affordable housing benefits from advances in building design and materials that reduce monthly energy costs and improve comfort and resilience. DCHA serves more than 20,000 households across the District, including its public housing. DCHA also partners with landlords to provide housing options to individuals and families through the housing choice voucher and project-based voucher programs. DCHA will play an essential role in ensuring local equity issues and priorities are considered in the final design and implementation of recommended policies and programs. DCHA should be considered a key stakeholder.

While the District has continually pushed building energy performance, and both DGS and DCHA have taken on leadership roles and organizational mandates in the pursuit of efficient low carbon buildings, more needs to be done to improve the performance of existing buildings. This section provides recommendations to help the reduce energy consumption and improve energy efficiency across the built environment.

⁹⁸ DCSEU Annual Reports from FY 2012 to FY 2016, <https://www.dcseu.com/about>

⁹⁹ DCSEU. Annual Report Fiscal Year 2017

¹⁰⁰ Discussion with DCSEU leadership on Dec 8, 2017.

¹⁰¹ BuildSmartDC, <http://www.buildsmartDC.com/>

¹⁰² With respect to District buildings, DGS should report annual energy consumption, energy savings, carbon emissions and progress against goals publicly in a standard format year-over-year for increased visibility and accountability.

¹⁰³ District of Columbia Housing Authority, Mission and Vision, <http://www.dchousing.org/topic.aspx?topicid=21>

4.2.2 BUILDING ENERGY BENCHMARKING IN THE DISTRICT

The District took a significant step to reduce energy use and emissions from the existing building sector with its 2008 approval of the *Clean and Affordable Energy Act* (CAEA). The CAEA requires owners of large privately-owned commercial and multifamily buildings, and all publicly-owned buildings, to report their energy consumption in a process called energy benchmarking. Building owners enter building performance information into the EPA's ENERGY STAR® program to compare building energy use across multiple building types and multiple states.

For key building types, a score from 1-100 can be issued to demonstrate a given building's performance relative to others in its class (e.g., office, retail, hospital, etc.). Because the score adjusts for the building's actual use, a building with very intensive uses and thus high energy intensity (e.g., data centers or buildings with 24-hour operations) can still receive a relatively high score. Buildings that achieve a minimum score of 75 are recognized for their high-performance via the ENERGY STAR certification program.

Beyond simply reporting their benchmarking data, the Act also requires public disclosure of benchmarking results. In 2010, public buildings larger than 10,000 square feet were required to benchmark and report their data, followed by private buildings over 100,000 square feet in 2013, and buildings over 50,000 square feet by 2014.¹⁰⁴ The benchmarking data is available for download or viewing on a interactive map at www.EnergyBenchmarkingDC.org.

Not all buildings are required to benchmark their performance, as the ordinance exempts certain categories. These include buildings that share a tax lot but do not share energy consumption (separately metered), and special cases where the owner has requested an exemption. It also exempts single-family residential spaces; however, DOEE facilitated a Single Family and Small Multifamily Working Group to explore alternative ways of engaging this sector. Finally, federal government buildings, foreign embassies and international inter-governmental organizations (IGO) are not covered.

However, federal facilities are required to benchmark and disclose energy performance under the *Federal Energy Independence and Security Act of 2007* (EISA 2007). Executive Order 13693 additionally requires federal buildings to “[conform], where feasible, to city energy performance benchmarking and reporting requirements.” It is also worth noting that more than 70 embassies in the District have signed a sustainability pledge with the District to share energy performance data with DOEE. However, to date very few have done so.^{105,106} As such, an update to the District's ordinance to include federal buildings could be effective in compelling federal government to report.^{107,108,109}

This dataset has a broad potential. Analyses can be conducted for both portfolios of buildings across the District as well as individual buildings. Comparisons across buildings of different size, type, age, or zip code allow us to identify broad trends in energy usage. Trends can also be identified using factors such as market type, parking area, and fuel source to understand typical building characteristics within the District and how they come to affect energy consumption. To help improve the accuracy and thus usefulness of the dataset even further,

¹⁰⁴ District of Columbia Department of Energy and Environment, 2011, Clean and Affordable Energy Act of 2008, <http://doee.DC.gov/publication/clean-and-affordable-energy-act-2008>. D.C. Official Code 6-1451.03(c); 20 DCRM 3513.

¹⁰⁵ U.S. Government Printing Office, Energy Independence and Security Act of 2007, <http://www.gpo.gov/fdsys/pkg/BILLS-110hr6enr/pdf/BILLS-110hr6enr.pdf>.

¹⁰⁶ Diplomatic Mission and International Institutions Environmental Performance, Climate and Sustainability Pledge, www.sustainableDC.org/diplomatic-mission-and-international-institutions-environmental-performance-climate-and-sustainability-pledge

¹⁰⁷ U.S. Government Printing Office, Energy Independence and Security Act of 2007, <http://www.gpo.gov/fdsys/pkg/BILLS-110hr6enr/pdf/BILLS-110hr6enr.pdf>.

¹⁰⁸ Diplomatic Mission and International Institutions Environmental Performance, Climate and Sustainability Pledge, www.sustainableDC.org/diplomatic-mission-and-international-institutions-environmental-performance-climate-and-sustainability-pledge

¹⁰⁹ Executive Order 13693 – Planning for Federal Sustainability in the Next Decade, March 19, 2015, Section(3)(a)(i)(G). <https://www.whitehouse.gov/the-press-office/2015/03/19/executive-order-planning-federal-sustainability-next-decade>

DOEE offered a grant to New York University's Center for Urban Science and Progress (CUSP). CUSP's research resulted in a preliminary strategy for data cleaning that merges disparate datasets, removes duplicate entries, identifies and removes significant outliers, and removes entries that lack critical pieces of data.¹¹⁰ The CUSP team also developed an algorithm for evaluating relative quality of the data.¹¹¹

The *Clean Energy DC* team used the resulting datasets to guide the recommendations and analysis in this chapter, along with the model results discussed in chapter in Chapter 2 and Appendix A1. Indeed, this plan is perhaps the first energy plan in the country to draw on localized benchmarking data to inform its modeling and recommendations.

4.2.2.1 SAVINGS POTENTIAL IN THE DISTRICT'S EXISTING BUILDING STOCK

The District's benchmarking dataset shows that, in many ways the District is doing comparatively well in terms of building energy use. To begin, the average ENERGY STAR score for District Office buildings of 74 as of 2016 sits well above the national average of 63.¹¹² The Washington, DC metropolitan region has been ranked as first in the nation for the number of ENERGY STAR certified buildings in 2015, 2016, and 2017, and has been among the top five cities since EPA started the "Top Cities" ranking in 2009.¹¹³ However, as buildings are only eligible for ENERGY STAR certification once they hit a score of 75, there is still room to improve energy performance even in the District's relatively advanced commercial building stock.

Further, several other sectors have ENERGY STAR scores lower than the national average. For example, the District's average score for the hotel sector is 44, while the median score for multifamily buildings is 62.¹¹⁴

Insights such as these will continue to be important tools for understanding how best to allocate funding for energy efficiency outreach and programming, and target policy efforts toward the most efficient outcomes. Additional details on the recommended uses of this and other datasets, as well as other policy and programming options, are presented below. Multiple studies in various jurisdictions do indicate that the transparency created by benchmarking does drive real-world energy-use reductions.^{115,116,117} No such research has yet been undertaken in the District.

Because of the uncertainty in this very new area of research, the danger of double-counting, and the fact that the District's benchmarking law predates this plan, these savings potentials have not been incorporated into the model at this time. Nonetheless, the value of these policies should not be underestimated.

¹¹⁰ Kontokosta, C. et. al. Benchmarking and Data Quality Analysis of Energy Disclosure Data for Washington, DC New York University Center for Urban Science and Progress. October 28, 2015. Internal copy provided by DOEE.

¹¹¹ Kontokosta, Contantine, Bartosz Bonczak, and Marshall Duer-Balkind. 2016. "DataIQ – A Machine Learning Approach to Anomaly Detection for Energy Performance Data Quality and Reliability." Proceedings of the 2016 ACEEE Summer Study on Energy Efficiency in Buildings in Asilomar, CA. Washington, DC: American Council for an Energy Efficient Economy. http://aceee.org/files/proceedings/2016/data/papers/12_1139.pdf

¹¹² Energy Use in Offices, part of EPA's Data Trends Series, http://www.energystar.gov/sites/default/files/tools/DataTrends_Office_20150129.pdf

¹¹³ U.S. EPA. ENERGY STAR Top Cities, 2016 and Past Rankings. https://www.energystar.gov/buildings/top_cities_past_rankings

¹¹⁴ DOEE Benchmarking dataset.

¹¹⁵ Palmer, Karen, and Margaret Walls. 2015. "Can Benchmarking and Disclosure Laws Provide Incentives for Energy Efficiency Improvements in Buildings?" Resources for the Future. Washington, DC. <http://www.rff.org/files/Sharepoint/WorkImages/Download/RFF-DP-15-09.pdf>

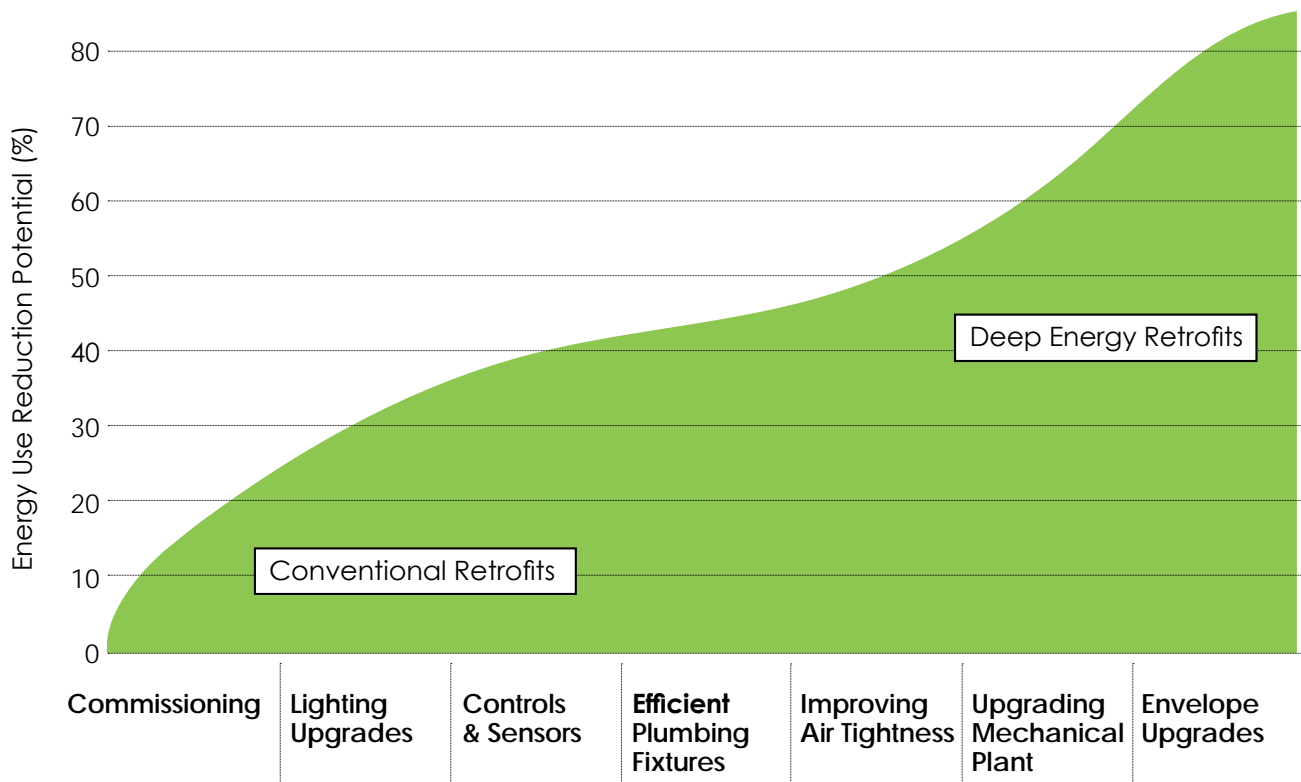
¹¹⁶ Meng, Ting, David Hsu, and Albert Han. 2016. "Measuring Energy Savings from Benchmarking Policies in New York City." Proceedings of the 2016 ACEEE Summer Study on Energy Efficiency in Buildings in Asilomar, CA. Washington, DC: American Council for an Energy Efficient Economy. http://aceee.org/files/proceedings/2016/data/papers/9_988.pdf

¹¹⁷ Bannister, Paul, Lane Burt, and Adam Hunge. 2016. "Under the Hood of Energy Star and NABERS: Comparison of Commercial Buildings Benchmarking Programs and the Implications for Policy Makers." Proceedings of the 2016 ACEEE Summer Study on Energy Efficiency in Buildings in Asilomar, CA. Washington, DC: American Council for an Energy Efficient Economy. http://aceee.org/files/proceedings/2016/data/papers/9_480.pdf

It should also be noted that additional actions relevant to existing buildings can be found in section 4.3, which includes actions targeting the entire building sector. Several recommendations from DOEE's Single Family and Small Multifamily Working Group have been included below, while others can be found in the Group's report.¹¹⁸ The District Government should review and consider these recommendations in addition to those below.

4.2.2.2 EXISTING BUILDING RETROFITS

A building energy retrofit involves the improvement of an existing building's energy performance through upgrades of lighting, HVAC systems, building envelope, or a variety of other interventions, including larger interventions involving extensive upgrades, such as fuel switching to eliminate fossil fuel dependency from heating needs. Figure 18 places a sampling of retrofit components (bottom) along a continuum characterized by their general energy use reduction potential (left). Retrofitting a building is an excellent way to reduce energy use and emissions from the existing building stock, and complements building energy benchmarking. There are best practices associated with different types of retrofits that demonstrate which approaches offer the biggest return on investment in terms of energy savings. The following is an overview of the best industry practices from conventional and simple retrofits to deep energy retrofits.



↑ **Figure 18:** Sampling of retrofit components against general energy use reduction potential

¹¹⁸ Department of Energy and Environment, GREEN RESIDENTIAL SOLUTIONS – Recommendations from the Single Family Small Multifamily Green Buildings Working Group, July 2016.

CONVENTIONAL ENERGY RETROFITS

Conventional building retrofits are typically energy efficiency improvements to buildings that do not require major time and money investments, yet they can generate savings for both building owners and operators. The measures taken to reduce energy use intensity through conventional energy retrofits can lead to savings up to 30 or 40%. Prior to undertaking any building retrofit upgrades, the District Government should undertake a whole building analysis to identify worthwhile investments and areas of improvement with the highest return on investment. This should include an energy audit, to determine if current systems are performing optimally. Generally, conventional building retrofits cost less than deep energy retrofits, but will create considerable savings to energy and costs. A conventional retrofit might combine one or more of the following examples of upgrades:

- **Lighting:** Reducing energy use in lighting needs includes the incorporation of energy efficient lighting systems, daylighting, and motion sensors in appropriate locations. An oft-heard quick fix to energy use reduction is to switch to LED lightbulbs, an example of an easily implemented conventional energy retrofit.
- **System Controls:** To reduce energy use when the building is unoccupied, or to adjust to end user needs, system controls can be upgraded to allow for greater adjustment sensitivities. Motion and occupancy sensors are examples of easy to install and low-cost retrofits.
- **HVAC:** HVAC systems account for as much as 40% of a commercial building's energy use ¹¹⁹, and easy adjustments to a building's HVAC system can help greatly reduce energy inefficiencies. This might be as simple as an annual tune-up of HVAC equipment, retrocommissioning, or installing a programmable thermostat to reduce energy use when the building is unoccupied.
- **Envelope:** Opportunities to improve airtightness will help lower heating needs, and is a highly cost-effective retrofit tool. Air sealing windows and doors with weather strips, or sealing gaps around wiring with caulking are examples of simple retrofits.
- **Equipment efficiencies:** Though replacing equipment is often costly and may require larger or whole system upgrades, a simple calculation to determine current annual energy use of an appliance may reveal that an upgrade to a higher efficient model may produce a quick return on investment. For example, ENERGY STAR rated washers and washer-dryer combos can save an average of \$45 a year on utility bills compared to a standard model ¹²⁰.

DEEP ENERGY RETROFIT

As described in section EB.3, a deep energy retrofit is a building-specific, whole-building analysis designed to identify points in the building lifecycle where investments in energy efficiency can achieve the highest return. They involve bigger measures, such as replacing all windows to reduce heating and cooling loads—which in turn can allow a switch to building equipment that requires less energy. A deep energy retrofit may occur over a few years, and will require a more significant financial commitment than conventional energy retrofits. The energy savings created with a deep energy retrofit are generally greater than 40%.

These principles allow those wishing to undertake a deep energy building retrofit to maximize returns and invest in the longevity and value of the building. Deep retrofits look beyond the immediate return on investment. For example, a deep lighting retrofit may attempt to reduce

¹¹⁹ https://www.eia.gov/energyexplained/index.cfm?page=us_energy_commercial

¹²⁰ https://www.energystar.gov/products/appliances/clothes_washers

loads through adding strategic windows to provide natural daylight. The Rocky Mountain Institute has an extensive guide to Deep Energy Retrofits, and cites 10 process oriented principles to follow (see Box 4).¹²¹

Rocky Mountain Institute's *Deep Energy Retrofit Report* (2012) outlines 10 design steps to help attain the greatest energy reductions and integrate whole building retrofits.

- | | |
|---|--|
| 1 Define specific end-user needs | 6 Select appropriate and efficient HVAC systems |
| 2 Assess the existing building structure and systems | 7 Find synergies between systems and measures |
| 3 Specify the scope and costs of planned or needed renovations | 8 Optimize controls |
| 4 Reduce loads | 9 Realize the intended design |
| 5 Determine how loads can be met passively | 10 Celebrate success |

↑ **Box 4:** Key Design Steps to Achieving Deep Energy Retrofits ¹²²

The following are some major examples of a few different areas of focus for deep retrofits:

LIGHTING

- Daylighting: Explore opportunities to reduce load through daylighting, whether through major reconfiguration of the building envelope (including new windows, strategically placing windows, exterior shading devices) or reconfiguration of interior space to redirect light.
- Efficient electric lighting: Address lighting needs individually to provide illumination only where and when it is needed. For example, ambient lighting in an office place is usually very high to light up desks as well as hallways, when separate and more directed task lights can be used and allow for lower ambient lighting in spaces not requiring high concentration or wakefulness.
- Lighting controls: Install controls to minimizing lighting when the building is unoccupied, or when daylighting is sufficient.

PLUG AND MISCELLANEOUS LOADS

- Reduce loads: Assess building equipment necessity, efficiency, and relevance, and replace where appropriate. Building operators may reason that equipment should be used to the end of its useful life, but it is important to assess energy cost savings, and make an informed decision to replace obsolete equipment.
- Controls: Consider an energy management system that will shut off unused devices.

¹²¹ Rocky Mountain Institute. Identifying Design Opportunities for Deep Energy Retrofits. https://d231jw5ce53gcq.cloudfront.net/wp-content/uploads/2017/03/Pathways-to-Zero_ID-Opps-for-Deep-Retrofits_Report_2012.pdf

¹²² Rocky Mountain Institute. Identifying Design Opportunities for Deep Energy Retrofits. https://d231jw5ce53gcq.cloudfront.net/wp-content/uploads/2017/03/Pathways-to-Zero_ID-Opps-for-Deep-Retrofits_Report_2012.pdf

- Education: Educate occupants on strategies to reduce energy use, and consult them on upgrades to ensure they will meet their needs. This helps reduce plug and miscellaneous loads, caused by occupants plugging in their own solutions.

BUILDING ENVELOPE

- Roof and Walls: Seal cracks in a building's exterior walls to reduce unwanted passing of heated air or water. Insulation is the next concern, as energy used to warm a building is often as much as 25% of a commercial building's energy use¹²³, and goes up to approximately 50% of a single-family building's energy use¹²⁴. In terms of unwanted heat gain, shading and reflection of light are two approaches to keep the building cool.
- Doors/Windows: Other than proper weather-sealing for windows and doors, a deep energy retrofit is an ideal time to assess whether doors and windows could be replaced for higher efficiency units, or reinstalled due to poor installation the first time around.

HEATING, VENTILATION, AND AIR CONDITIONING (HVAC)

- A deep energy retrofit offers a suitable opportunity to replace an HVAC system, and there are many factors to consider when specifying a new setup. These include planning and accounting for the climate, occupancy, natural ventilation, the zoning of the building, and comfort requirements for the space.
- Other possible considerations in HVAC retrofits include heat or energy recovery from exhaust air, optimizing HVAC controls through direct digital systems to minimize energy use (e.g., during unoccupied periods), and replacement of pumping systems.
- More efficient HVAC systems often require more regular maintenance and more careful installation, so that should be planned for as well.

FUEL-SWITCHING

- Reducing energy use will help reduce a building's total greenhouse gas emissions, but fuel switching is required to reduce the greenhouse gas intensity (or carbon intensity) of a building's energy. This is often a large undertaking.
- Prior to choosing an appropriate fuel to switch to, a building manager should calculate the emissions of each of the building's energy uses, such as electricity, fuel, and chilled/hot water consumption, and refrigerant use.
- Natural gas and other carbon-intensive heating furnaces can be switched to a low-carbon energy source such as a high-efficiency electricity-based heat pump.
- These switches are sometimes combined with the sub-metering of a building's electricity use.

OTHER CONSIDERATIONS

It is important to note that retrofits will vary for different types of buildings suited to different end-user needs. For example, certain commercial and institutional buildings may require service water heating for end uses such as dishwashing, swimming pools, or laundry facilities, and this would be a major point of focus for an energy retrofit. In addition, commercial and institutional buildings often have much larger plug loads to service large numbers of electronics, and as the base building systems become more efficient, these plug loads become a bigger challenge; plug loads often accounting for as much as 40-60% of all electricity consumed in highly energy efficient office buildings.¹²⁴

¹²³ EIA. Energy use in commercial buildings.

¹²⁴ EIA. Heating and cooling no longer majority of US home energy use.

¹²⁵ New Building Institute. Managing Your Office Equipment Plug Load. <https://newbuildings.org/wp-content/uploads/2015/11/PlugLoadBestPracticesGuide1.pdf>

4.2.3 RECOMMENDED ACTIONS

4.2.3.1 ENERGY EFFICIENCY INCENTIVES AND MANAGEMENT

EB.1 Increase access to building energy performance data for energy efficiency programs

Action: Improve the access of the District of Columbia Sustainable Energy Utility (the DCSEU), DC PACE, and any future DC Green Bank to building energy information to target buildings with the highest energy-savings potential.

Relevance: Like most DSM programs across the nation, the DCSEU offers services on a largely first-come, first-served basis, with little effort to target specific customers. However, the DCSEU could vastly improve its effectiveness by targeting those buildings with the greatest potential for energy efficiency improvements. To do so, the DCSEU would need to access existing building energy-consumption data, combined into a single user-friendly platform with information accessible in an actionable format.

Understanding the characteristics and performance of the building stock will allow the DCSEU to target programs effectively and engage building owners and managers directly. As a part of this effort the District should provide the DCSEU with the most current and accurate information available on building stock and its energy performance on a regular basis. It should share this information with the DC PACE program and any DC Green Bank, to facilitate streamlined operations across the District's rebate, financing, public education, and technical-assistance programs.

Details: Several sources of data would assist the DCSEU in improving the effectiveness of its programs and services, and better leverage existing District financing programs.

Benchmarking data: DOEE publishes summary data on every building that reports benchmarking data, beginning with the second year of data for each building. However, DOEE also provides more detailed benchmarking data to the DCSEU and the DC PACE programs, which provides a snapshot of the annual energy performance and different characteristics of the District's built stock, along with contact information for building owners and managers. DOEE should continue to share the full set of benchmarking data with DCSEU and DC PACE under appropriate confidentiality agreements, while moving to make summary benchmarking data on each building available to the public more rapidly. While the annual benchmarking data is useful, monthly energy usage data would allow further insight into building energy consumption under different climatic conditions, system loads, and operating characteristics. It would also allow the isolation of the building base-load from its seasonal heating and cooling load, indicating their potential for lighting or other building upgrades. To collect monthly data from Portfolio Manager®, District Government staff should continue to work with their counterparts from other cities to help program staff at the EPA to overcome any technical hurdles associated with the transfer of monthly, rather than annual, energy consumption data.¹²⁶

¹²⁶ An alternate path forward would be using the EPA Portfolio Manager Web Services option rather than changing the granularity of information sent through the Reporting Template. Using Web Services would require a regulatory change to the District's rulemaking, which includes provisions that ordinance-subject building owners must submit District Benchmark Results and Compliance Report to the District, via the District Benchmark Reporting Template.

Utility Meter Information: As an independent organization, the DCSEU cannot access individual meter-level or building-level energy consumption data directly from District utilities, nor can it access the metering configuration of District buildings. This makes it highly unusual in the national context; most DSM programs access utility data either by default (if operated by the electric or gas utility) or under data sharing agreements (if operated by a third party). This information would provide important insight into both the quantity of energy consumed by different buildings, as well as the way in which this energy is divided among individual customers (e.g., master-metered vs. tenant-metered). If the District Government required Pepco and Washington Gas to share such data directly with the DCSEU, it would improve the organization's overall effectiveness by allowing it to target the highest-potential energy savings projects.

In addition, the District Government should find a way for the DCSEU to access real-time utility data. Efficiency Vermont, that state's DSM provider, has already established a similar program. There, account managers are given access to smart meter information for homes and businesses.¹²⁷ The managers use this information to conduct aggregate analyses, identify trends, customize savings recommendations, and improve outreach practices. Similarly, access to such data would help the DCSEU verify actual energy savings following an energy-saving action or retrofit—increasing the accuracy of annual metrics. Access to smart meter data will also allow the DCSEU to dramatically increase the sophistication of its analysis and targeting.

Grid Information: The DCSEU could further enhance its effectiveness if Pepco were to offer notifications on when and where the grid is experiencing stress at the feeder level. Targeting buildings on these feeder lines for energy efficiency improvements would help stabilize the grid, maximize the value of energy efficiency, and create room for on-site renewable energy capacity.

Supplemental data: Under the current benchmarking ordinance, the District collects general building information (i.e., street address, year built, size, occupancy), property use data (i.e., gross floor area and operating characteristics), and energy and water performance data. However, more detailed building system and construction data would allow the DCSEU to better target buildings with high energy savings potential.

New York City's Retrofit Accelerator program serves as an example of this approach. It offers building owners and operators free, independent, and building-specific technical assistance and advice on energy and water efficiency. The program targets buildings with high savings potential, via a combination of public and non-public datasets collected under Local Law 84 (for energy and water benchmarking) and Local Law 87 (for energy audits and retro-commissioning).

By combining these datasets, Accelerator staff can identify high-priority buildings, and connect decision makers with resources to help with efficiency planning and upgrades. The Retrofit Accelerator is collecting audit and retrocommissioning data that is not currently available to the District Government. However, if the District Government chooses to adopt a Building Energy Performance Standard (BEPS) program (see Action EB.5), it will generate detailed audit information for the lowest-performing buildings. Similarly, citywide virtual energy audits will generate estimated but still highly useful audit data (see Action EB.8). This data should also be shared, under strict confidentiality protections, with DCSEU and the District's green finance programs.

¹²⁷ Efficiency Vermont's Privacy Policy, <https://www.efficiencyvermont.com/about/privacy-policy#What>

Green Building Act data: Finally, the District Government should merge the Department of Consumer and Regulatory Affairs' (DCRA) Green Building Act dataset with energy benchmarking data, and subsequently shared it with the DCSEU. The DCRA dataset includes ENERGY STAR Target Finder scores based on the modeled energy performance of new construction and major renovations of large publicly- and privately-owned buildings.

Combining this dataset with benchmarking data would allow the District Government to link modeled energy performance with actual energy performance over the course of building operations. However, the District Government would need to develop building-specific identification numbers, to be required across agencies, to map them together. To date, DOEE has faced difficulties in matching its benchmarking datasets with any datasets maintained by DCRA due to varying building identification numbers.

Next Steps

- 1 In 2018-2019, the District Government should standardize building identification numbers, to consolidate building-specific information into a single resource. One promising option is using the DOE and Pacific Northwest National Laboratory's new Unique Building Identifier (UBID) specification. Once established, the District Government should link this UBID to existing datasets and share across agencies for use in efficiency program development, using nondisclosure agreements where necessary.
- 2 In 2018, grant the DCSEU and DC PACE programs access to applicable datasets that are controlled by DC agencies, and direct the DCSEU to consolidate those datasets into one streamlined CRM program—including the SEED Platform and available contractor software systems. Share access, as appropriate, with District Government agencies that work in the existing-building space. Consider case, workflow evaluation, and security implications when sharing data between agencies.
- 3 Continue working with the EPA to access monthly as well as annual energy data, and begin collecting this data if/once that agency makes it available.
- 4 Continue to work with the Public Services Commission (PSC), the Office of People's Counsel (OPC), the DCSEU, and the utilities to investigate the best path to granting access to real-time, granular interval energy consumption information of utility customers to the DCSEU, under strong non-disclosure requirements, in addition to information regarding congested or highly-burdened feeder lines.

EB.2 Increase DCSEU flexibility

Action: Increase the ability of the DCSEU to target expanded target saving areas.

Relevance: To help the District achieve its emissions targets, the DCSEU will need to target new opportunities to save energy. This will require an increase in the DCSEU's flexibility and in the type of offerings that it can provide.

Details: Provide the DCSEU with access to any potential tool that helps it achieve its targets at the lowest practical cost. Recommendations for the development and use of specific tools are listed below.

Projects with potential savings of over a year: Demand side management programs in states such as New York, Oregon, Vermont and New Jersey recognize the potential return on investment in energy efficiency is greatest before and during building design.¹²⁸ To allow the DCSEU to address long-term projects with time lines greater than a single year, the DCSEU needs to be able to operate over more than one year. The District took a critical step in this direction during the 2016 request for proposal (RFP) process by extending the base contract period from one to five years, and by offering a five-year renewal option.¹²⁹ VEIC, which oversees the contract, is now in the second year of its new five-year term. This has already had a positive impact on the depth, complexity, and savings of DCSEU projects. However, additional improvements may be needed to properly incentivize the DCSEU to seek deeper, longer-term energy savings.

To this end, the District Government should credit the DCSEU for work and energy saving achieved through the life of its programs. This should include a direction to work with building owners and contractors from the very beginning of the new construction process by helping them to set goals, develop an RFP, and select a design team. The DCSEU should then work with design and construction teams from conceptual design through building delivery to maximize energy savings.

Such changes will encourage the DCSEU to undertake projects that produce savings over several years, or projects that only produce savings beyond the first year of program implementation (e.g., new construction). This will increase the number, type and cost-effectiveness of projects that the DCSEU can undertake. Special care should be given to credit savings in the final years of the contract, prior to the option period, to ensure that these benefits of the multi-year contract are not lost due to the limited time remaining.

Operational energy management: Operational improvements to building performance include changes to building operational hours, adjustments to equipment settings, maintenance of systems and technologies, installation of sensors for lighting and thermostats, and real-time energy management. They can also involve behavior-based programs. Since no organization has yet produced a verifiable standard for measuring the quantity and persistence of savings from these activities, the DCSEU does not currently incentivize operational energy.

The DCSEU should investigate the market for these and other kinds of operational improvements with an aim of understanding the current and potential market size. Similar investigations have led to operational energy management programs in other jurisdictions, including California, Minnesota, Chicago, Massachusetts, Maryland and New York. If market conditions are similar, the District should consider adopting an appropriate methodology for estimating the

¹²⁸ For example, see new construction programs in New York (www.nyserda.ny.gov/All-Programs/Programs/New-Construction-Program) and Oregon (<https://energytrust.org/commercial/construction-renovation-improvements/>).

¹²⁹ RFP No. DOEE-2016-R-0002 For District of Columbia Sustainable Energy Utility Contractor, February 19, 2016, http://doee.DC.gov/sites/default/files/dc/sites/ddoe/publication/attachments/DCSEU%20RFP_DOEE-2016-R-0002_FINAL.pdf

persistence of savings from operational energy management in commercial and residential buildings, and incorporate that methodology into the evaluation, measurement and verification (EM&V) of the DCSEU's savings and incentive structure.

Coordination with other agencies, instrumentalities and service providers: To improve the efficiency of its programs and services, the DCSEU should coordinate and work with other entities that share its goals. These include District Government agencies, instrumentalities, and administrators such as DC PACE, as well as any potential Green Bank (see section 1.6). The DCSEU should be incentivized to cooperate, not compete with these agencies and service providers. An easy and efficient way to do so would be to credit the DCSEU with all or a portion of the energy savings, renewable energy capacity increase, and green jobs attributable to DC PACE and any future DC Green Bank projects so long as DCSEU was involved in the project—even if that involvement came from technical assistance rather than direct incentives.

Equity and affordability are, again, other important considerations. The DCSEU already targets 20% of its funding to low-income developments, with a requirement that 5 to 10% of the savings come from projects serving low-income populations. As the DCSEU's work grows and expands, and as the District Government introduces new entities such as a Green Bank to support building energy and emissions reductions, the DCSEU should engage with LMI-focused community organizations to identify any equity opportunities and risks associated with potential changes, and incorporate them in program design and implementation.

Integration between the DCSEU and the District's green finance programs: As the District's green financing programs mature there are strong opportunities for collaboration that will help all parties. The District should recommend the establishment of a joint marketing and outreach program between the DCSEU, the DC PACE program and the potential DC Green Bank (as discussed in Action CCB.1). The DCSEU can offer technical assistance services to customers that encourage residential and commercial building owners to implement deeper retrofits, with costs reduced both through available and expanded DCSEU incentives, so that financing from the DC Green Bank can cover the remaining capital costs of the project. By providing a mechanism for property owners to access deeper savings with no up-front cost barrier, such a marketing program will help to avoid instances where organizations focus solely on the lowest hanging fruit or implement only those measures with dedicated rebates. Additionally, to support this effort, the DCSEU should have a clear mandate to provide technical assistance to customers by offering energy audits or other building-level or project reviews that are tailored to the underwriting requirements of capital providers, in particular, the DC Green Bank and its partners. By coordinating project origination efforts with the DC Green Bank and handing off data that is directly applicable to future financing, the DCSEU will streamline project development and lower transaction costs for property owners and encourage increased uptake of these programs. The DCSEU should be able to receive credit for the energy use and carbon reductions for any DC PACE or Green Bank projects supported were also by DCSEU analysis or incentives.

Code compliance: The DCSEU should assist DOEE, DCRA, the Green Building Advisory Council and the Construction Code Coordinating Board to develop and implement building-code improvements. The DCSEU should also design outreach and incentive programs for building owners, designers, and contractors with an eye to laying the foundation for future building code improvements.

To incentivize such investments, the DCSEU should be credited for a portion of any energy savings attributable to the adoption of energy-saving building code improvements, as is the case in Arizona utilities.^{130,131} To maximize the energy savings realized from building code improvements, the DCSEU should invest resources in training, outreach, technical assistance, design assistance, marketing, explanatory materials, and other efforts to increase compliance with building codes. As codes become more ambitious, the DCSEU should receive credit for bringing poor performing buildings up to code. As the District has little history of crediting a demand-side management administrator for code-related energy savings (except in cases where the building is making improvements prior to the end of the life of the equipment being replaced, and outside of a renovation project), this would need to be resolved through an evaluation, measurement, and verification review and the subsequent development of appropriate guidelines.

Tracking GHG reductions: The DCSEU has five performance benchmarks under its new contract: Reduce energy consumption, increase renewable energy generation capacity, target low-income communities, create green jobs, and leverage external funds. It is also expected to track and report semiannually on its progress on reducing peak demand and addressing the District's largest energy users.

Given the Plan's strong focus on GHG emissions, the District Government should also track and report out on the DCSEU's progress in reducing greenhouse gas emissions. Given that natural gas is currently less GHG intensive than the electricity grid, but that the electricity grid is decarbonizing while natural gas cannot be decarbonized, it may not be appropriate to establish GHG savings as a performance benchmark. Without explicit recognition of the ultimate importance of long-term and permanent GHG reductions, using GHG savings as a benchmark could unintentionally incentivize fuel switching away from electricity and towards natural gas, which would be contrary to the long-term carbon reduction goals of the District. However, it is important that DOEE and the DCSEU are aware of the GHG impacts of each DCSEU project and the DCSEU portfolio so the District should take steps to incorporate GHG savings into the data tracked by the DCSEU.

Consider fuel-agnostic energy savings: The District Government designed the DCSEU to be a nimble, flexible institution that would seek the greatest energy and GHG emissions savings for ratepayers with as few limitations as possible, and without regard to fuel source. As such, the original CAEA did not require the DCSEU to track electric and natural gas savings separately; these requirements were later added during the drafting of the DCSEU RFP—and indeed, are common in the industry.

However, eliminating these requirements would remove an impediment to whole system strategies (e.g., passive solar design) for which costs and savings must be arbitrarily allocated between electric and gas. This would also free the DCSEU to pursue strategies aligned with the District's 2050 carbon neutrality commitment. To achieve this level of savings, the District will need to seize all opportunities to minimize fossil fuel consumption, while keeping the long-term trend of decarbonization in mind.

For example, large-scale switching of electric systems to natural gas might yield short-term savings, but would be counter to long-term carbon reduction targets. As a first step, DOEE and DCSEU should properly credit and incentivize the DCSEU to invest in projects that switch buildings from fuel-oil heat to electricity or natural gas heating.

¹³⁰ *Attributing Building Energy Code Savings to Energy Efficiency Programs*, developed by the Northeast Energy Efficiency Partnerships (NEEP) Evaluation, Measurement and Verification (EM&V) Forum; the Institute for Market Transformation (IMT); and IEE, an institute of the Edison Foundation, February 27, 2013, <http://www.imt.org/news/the-current/leveraging-building-energy-codes-to-maximize-energy-savings>

¹³¹ Other jurisdictions, such as California, also provide utilities attribution for energy code adoption, but the Arizona model is most appropriate for a small jurisdiction like the District.

Minimize impediments to market responsiveness: As noted above, the DCSEU was intended to be entrepreneurial, flexible, and responsive to the market in ways that have generally proven difficult for government agencies and traditional utilities. The target was, and remains, to establish an innovative body that can experiment and make calculated bets by trying new approaches and maximizing energy savings and benefits to ratepayers and residents at the lowest practical cost. To achieve this target, the utility should minimize paperwork and impediments. Some examples include the following:

- The DCSEU is currently subject to a performance contract for SETF-funded work. If DOEE provides additional funds to the DCSEU's budget, those funds should also be subject to performance requirements, while the DCSEU should handle any aspects of program design. Certainty in the size and timing of any additional funding will improve their impact, as will the flexibility to incorporate them into longer-term planning. Any adjustment to the DCSEU's performance goals should account for this significant impact as well as for the existing funding shortfall relative to peer jurisdictions (see Action CCB.1).
- The District Government should empower the DCSEU to pursue a portfolio of strategies that it deems most likely to deliver on its mandated goals, and make quick course corrections in response to market conditions and feedback.
- The DCSEU should also be subject to a streamlined EM&V process, comparable with those in other jurisdictions. This streamlining should include a random sampling of professional installations rather than inspection and review of 100% of installations.
- To minimize the costs for building owners to participate in its programs, the DCSEU should minimize paperwork and inspection to a level below that in Maryland and to the level of national best practices.
- In short, the DCSEU and the District should work to streamline processes, eliminate bureaucracy and paperwork, and allow the DCSEU to operate as the truly flexible and nimble organization intended in the original CAEA.

Market transformation: Finally, the District should structure the DCSEU contract to encourage the utility to continue to engage in a full range of market transformation activities, including green leasing and training for brokers, appraisers, and other real estate professionals.

Next Steps

- 1 In 2018, direct the DCSEU to investigate the market penetration of operational energy management. If findings indicate a cost-effective opportunity to further incentivize operational energy management, direct the DCSEU to conduct a best practice review of other jurisdictions' approaches to estimating the persistence of savings, and any standard EM&V methods that the District can deploy.
- 2 Add a requirement that the DCSEU track and report to DOEE quarterly the impact of its programs on reducing GHG emissions attributable to the District.
- 3 As the District adopts more ambitious energy and green codes, revise the DCSEU incentive and performance structure to allow credit for their participation in code compliance activities. (This may require a legislative update.)

Next Steps

- 4 Ensure future DCSEU contracts can:
 - Pursue goals are aligned with the District's decarbonization targets
 - Avoid the need for prior approval for programs or course corrections
 - Last a minimum of five years without interruption across fiscal periods
- 5 Subject the DCSEU to a streamlined EM&V regime to minimize paperwork and bureaucracy and leverage the benefits of smart meters with M&V 2.0 practices. Use random sampling in place of 100% inspection and review processes and allow the DCSEU to use census tract data for income verification where appropriate. Implement these changes under the current DCSEU contract.
- 6 When revisiting existing programs, engage with LMI-focused organizations to fully consider specific risks and opportunities specific to those communities.

EB.3 Provide the incentives necessary to operate a District-wide deep energy retrofit program

Action: Improve the uptake of deep building energy retrofits by providing resources, training, and incentives.¹³²

Relevance: A deep energy retrofit is a building-specific, whole-building analysis designed to identify points in the building lifecycle where investments in energy efficiency can achieve the highest return. Please refer to Section 4.2.2.2 for further details on deep energy retrofits. These are often multi-year or ongoing efforts that require both operating and capital investments and that can achieve more than 40% reduction in energy consumption over time.¹³³

While deep retrofits can generate significant cost savings for building owners and operators, they also represent a considerable investment of time, money, and other resources that can make them unattractive. To overcome these barriers and drive the scale of retrofits necessary to achieve the District's GHG reduction targets, the District must invest in a set of incentives that make these added efforts worthwhile. These programs require financial investments by the District Government itself. However, a cost-benefit analysis has indicated that both the direct and indirect benefits of incentivizing net-zero and/or net-positive energy buildings outweigh the costs over a 10-year period.¹³⁴

Details: To improve the uptake of deep energy retrofits, the District should use pay-for-performance incentives, in which incentives are contingent on the actual measured performance of the building. Experiences in the District, as well as several other states, indicate that shifting to this form of energy efficiency programs can make retrofit programs both less expensive to operate and more effective in driving reductions.¹³⁵

¹³² Greening the District of Columbia: Incentives and Policies to Achieve Deep Green Building Construction and Renovations

¹³³ Rocky Mountain Institute. "The Path to a Deep Energy Retrofit", https://rmi.org/wp-content/uploads/2017/04/2015-02_Path_to_DR_using_ESPC.pdf

¹³⁴ Greening the District of Columbia: Incentives and Policies to Achieve Deep Green Building Construction and Renovations.

¹³⁵ Ibid.

These incentives should also be set up in such a way that incentives are non-linear, in that greater energy savings are rewarded with greater financial incentives. In this way, a building that achieves a 50% reduction in energy consumption can receive a significantly larger package of incentives than a building that achieves only a 25% reduction in energy consumption. This non-linear approach aligns with existing retrofit cost estimates, where deep energy retrofits can cost around twice as much per square foot as conventional retrofits, depending on the scale and scope of the retrofit (e.g., the building components affected).¹³⁶

As with net-zero ready construction, governments and other organizations are increasingly investigating retrofit costs as part of learning how to stimulate them. Should the District Government decide to examine potential retrofit costs, for example, to determine incentives, it should focus on the local context to generate insights more appropriate to local builders, building owners, and policymakers. This includes factors such as the characteristics of the District's existing building stock (e.g., existing office building heating systems, building component replacement timelines), the solutions (building components) appropriate for the local climate zone, and the capacity of the local workforce to cost-effectively procure necessary components and cost-effectively conduct the retrofits.

The District Government should offer incentives for residential, commercial, and institutional buildings, and transparently implement them. Where appropriate, retrofits and incentives should promote one size fits all solutions, such as attic insulation, air sealing, modulating boilers, water heaters, and LED lighting retrofits.¹³⁷

Pay-for-performance incentives are not, however, appropriate for all District residents, and risk excluding low-to-middle income residents and communities from accessing the available incentives. Instead of incentives, low-to-middle income communities will more likely benefit from sustainable and equitable loans, as well as on-bill financing, energy-literacy training, and energy-management coaching. The District should ensure low-to-middle income citizens, and social and affordable housing communities, are aware of the building energy performance actions.

Next Steps

- 1 In 2018, design the specific incentives identified above.
- 2 Work with the DCSEU and the EM&V contractor to introduce a pay-for-performance program in 2018.
- 3 Investigate options to provide financial incentives for energy retrofits and energy literacy training to LMI communities.
- 4 Work with the DCSEU and a potential Green Bank to implement a package of incentives targeting deeper energy use reductions by 2020.

¹³⁶ Based on a review of available estimates: Kok, N., Miller, N., Morris, P. "The Economics of Green Retrofits." December 2011; Energy Efficient Buildings Hub. "Deep energy Retrofit Modeling and Cost Effectiveness Study: A Technical Policy Brief." January 2013; Leinartas, H.A., Stephens, B. "Optimizing Whole House Deep Energy Retrofit Packages: A Case Study of Existing Chicago-Area Homes." May 2015.

¹³⁷ LED stands for light emitting diode.

EB.4 Coordinate and centrally track District efficiency and finance programs

Action: Coordinate existing demand-side management (DSM) incentive and financing programs and other economic development programs to ensure that incentives and benefits are tracked together and aligned.

Relevance: To streamline and consolidate the District's energy efficiency-related programs, align benefits and incentives offered by disparate programs.

Details: The DCSEU should closely coordinate with and support a new Green Bank (Action CCB.1), expanded PACE financing (see Action CCB.2), as well as all other DSM incentive and financing programs (such as those discussed in Action EB.3). In addition, these entities should coordinate with the finance and economic development programs offered by the District Government and District Instrumentalities, including but not limited to the District of Columbia Housing Finance Agency (DCHFA), the Department of Housing and Community Development (DHCD), DCRA, and the revenue bond program. Additionally, DOEE should explore ways to align its energy programs with the green infrastructure and stormwater programs. The DCSEU should also receive a credit for a portion of the energy savings, green jobs and other benefits that these various programs generate when coordinating program delivery and/or funding with the DCSEU to functionally align the separate initiatives' incentives. Finally, the District Government should consider a unified brand, so that residents perceive them as a cohesive package, and provide a simpler and more comprehensive energy concierge service to guide customers through the process.

Next Steps

- 1 Evaluate strategies for consolidating DSM incentive and financing programs to either bring all incentive and benefit programs under one umbrella, or ensure they work together.
- 2 Undertake department-wide review of opportunities to coordinate and leverage joint financing between energy programs and air quality and stormwater programs.



4.2.3.2 POLICY AND PROGRAM RECOMMENDATIONS

EB.5 Implement a Building Energy Performance Standard

Action: Enact a Building Energy Performance Standard that requires improvements in lower performing buildings over a continuously implemented, iterative five-year cycle.

Relevance: While the District's benchmarking policy has provided useful access to information on the building stock, next-generation policies require building owners to act, either by contracting an auditor to review building systems and operations against a certain standard or by requiring system upgrades.

Details: Building Energy Performance Standards (BEPS) establish mandatory building energy audits and/or retro-commissioning that either require and/or motivate building owners (and, in certain cases, tenants) to invest in the energy efficiency of their buildings. Such a policy would both reduce built environment emissions and provide the District with a more detailed understanding of building system characteristics. A task force initially outlined the BEPS concept for the District in 2014 as part of the *Sustainable DC*¹³⁸ implementation process; DOEE then further researched and analyzed it for *Clean Energy DC*. Similar requirements have grown in popularity over the last few years, with programs of varying types established in Seattle,¹³⁹ New York,¹⁴⁰ and Los Angeles,¹⁴¹ to name a few.

Additionally, an increasing number of jurisdictions are expanding their benchmarking programs to cover buildings smaller than 50,000 gross square feet. Seattle and other cities have experienced challenges expanding their benchmarking to buildings smaller than 20,000 gross square feet, because of the limited capacity of small building owners. However, thresholds of 25,000 or 35,000 square feet are increasingly common. The District should examine the benefits of expanding the threshold below 50,000 square feet, and the staffing requirements needed to support it.

The BEPS program should apply to all buildings covered under the District's building energy benchmarking program, phased in over two to three years—starting with the largest buildings first. As with Seattle's Building Tune-Up Program, the District may wish to develop an accelerator program for smaller buildings.¹⁴² The accelerator would provide an incentive to cover the costs of energy conservation actions for a small number of buildings, and refine the program design based on the experience.

With a five-year cycle, 20% of covered buildings would be eligible for BEPS each year, and all buildings would be evaluated every five years. This arrangement balances the number of efficiency projects that need to be completed in compliance with BEPS, creating a steadier flow of projects for local efficiency contractors. This also establishes a persistent requirement for existing buildings to ensure highly efficient performance.

As its primary indicator, the District should use ENERGY STAR score to determine whether a building must comply with BEPS. Buildings would be considered in compliance if they achieved a certain energy performance, and no additional action would be necessary. ENERGY STAR score is an appropriate metric for several reasons: First, the data is already collected in the District's benchmarking program. Second, ENERGY STAR scores are based on

¹³⁸ Sustainable DC Mayor's Order, Building Energy Performance Standards Task Force, December 10, 2014, <http://www.sustainableDC.org/wp-content/uploads/2014/12/10-Building-Energy-Performance-Standards.pdf>

¹³⁹ Seattle Building Tune-Ups, <https://www.seattle.gov/environment/buildings-and-energy/seattle-building-tune-ups>

¹⁴⁰ New York City Mayor's Office of Sustainability, Local Law 88, <http://www.nyc.gov/html/gbee/html/plan/l188.shtml>

¹⁴¹ Los Angeles Existing Buildings Stakeholder Group. Final Workshop, July 28, 2015, https://laexistingbuildings.files.wordpress.com/2015/01/150728_final-workshop.pdf

¹⁴² Building Tune-Up Accelerator Program, <https://www.seattle.gov/environment/buildings-and-energy/seattle-building-tune-ups/accelerator>

statistically-significant surveys of the country's commercial building stock, and normalize for key considerations like occupancy, weather, and building use, thereby providing a fair comparison across peer groups. Finally, the performance required to achieve a given ENERGY STAR score will steadily be pushed higher as the U.S. Energy Information Association (EIA) conducts updated national building energy surveys approximately every four years. EPA is expected to release the next update to ENERGY STAR scores in 2018, based on the 2012 DOE Commercial Building Energy Survey (CBECS).

After examining the benchmarking data, the *Clean Energy DC* team recommends that an appropriate threshold for the District's highly efficient office sector should be a minimum ENERGY STAR certification of 75. For all other building types subject to the ENERGY STAR scoring system, the threshold should initially be set to a minimum of 50—the national median. Setting a threshold of 50 ensures that government and industry will focus on the lowest-performing buildings in the early years. Building types without a means of scoring in ENERGY STAR should either be exempt or use the national median for the property type in question.

Buildings should be offered the opportunity to apply for an exemption under certain conditions. Beyond having a high enough ENERGY STAR score, buildings could be exempted if they hold certain certifications or have recently equivalent action to improve energy performance. Under Seattle's Building Tune-Up Program, exemplary performance options include LEED Gold or Platinum O+M and Living Building, Petal, or Net Zero Energy Certifications, among others, while equivalent action options include Active Monitoring and Continuous Commissioning, ASHRAE Level II Audit Recommendations, and Substantial Alteration or New Construction, among others.¹⁴³

Owners of affordable housing developments should also be eligible to apply for a short-term waiver to be exempt from BEPS. In exchange for a grace period, the owners would need to submit a long-term plan detailing a compliance path, or follow a similar requirement. For affordable housing developments required to take compliance actions, the District should also consider offering financial incentives to owners of affordable housing developments. To ensure the BEPS is applied fairly and consistently, the District should also introduce a requirement for verification of the benchmarking data by a licensed professional once every three years. Similar requirements exist in Chicago, IL, and Montgomery County, MD, and have increased data quality and reliability beyond what DOEE has been able to achieve with existing in-house enforcement resources.

Buildings that do not meet the minimum performance and do not qualify for an exemption would be required to take one of two compliance pathways: The Improvement Path, or the Prescriptive Path.

The District Government should use energy use intensity (EUI) to define compliance requirements for the Improvement Path. EUI is a more appropriate metric than ENERGY STAR score for tracking progress in this manner, because building owners and industry can more predictably estimate the impact of certain energy conservation actions on EUI. An ENERGY STAR score, on the other hand, depends on multiple factors beyond the building owners' control, thus making it more difficult to accurately manage. Buildings opting for the Improvement Path reduce EUI at least 15% below the average EUI of the two years leading up to BEPS compliance, within two years of triggering BEPS compliance. For example, a building triggering BEPS in 2021 based on its performance in 2020 would, by 2023, need to reduce its EUI at least 15% below its average EUI for 2019 and 2020. A properly licensed third party should verify this EUI reduction.

¹⁴³ Seattle Building Tune-Ups, How to Comply, <https://www.seattle.gov/environment/buildings-and-energy/seattle-building-tune-ups/comply>

Alternatively, building owners choosing the Prescriptive Path would be required to take one or multiple pre-determined actions to improve their energy performance. These actions should focus on more cost-effective energy conservation measures and actions that improve the knowledge and capabilities of building managers, to support ongoing performance improvements. Alternate compliance paths can include one or more of the following:¹⁴⁴

One-time lighting upgrade: Lighting remains one of the most cost-effective energy upgrades, and buildings below the minimum performance threshold are unlikely to have installed up-to-date lighting technology. Both New York City and Boulder, Colorado require one-time lighting upgrades from the buildings covered by their building performance policies. The lighting upgrade should be required for any buildings triggering BEPS that have not yet upgraded their lighting, regardless of whether they choose Improvement or Prescriptive path.

Energy audits: An audit is a detailed assessment of how a building could improve its energy performance through upgrading or retrofitting its energy systems. As proposed by the BEPS Task Force, an ASHRAE Level II audit (or higher) would be required, with the findings submitted to the District. This additional data collection would enable the District to further enhance efficiency targeting, following the model of NYC's Retrofit Accelerator.¹⁴⁵ This would require the data to be shared, confidentially, with the DCSEU and green finance programs (see Action EB.5 for more).

Retrocommissioning: This is a systematic process that evaluates and optimizes the existing base building systems (including the HVAC system,¹⁴⁶ electrical and lighting systems, and building envelope) to ensure that they are running properly. Typical retrocommissioning measures include recalibrating sensors and controls, and cleaning and repairing existing equipment; they do not include capital-intensive improvements such as equipment upgrades. Various studies have identified retrocommissioning as one of the most cost-effective procedures to increase the energy efficiency of existing buildings and have estimated that improved operations can deliver half of the reasonably available savings from energy efficiency for a portfolio of buildings.¹⁴⁷

Certification of building operators: Building operators waste an extraordinary amount of energy when they operate building systems inefficiently, or neglect them. A relatively inexpensive solution is to offer training in the operation and maintenance of relevant building systems. A building operator training and certification program prepares building operators to efficiently operate and properly maintain building energy systems. This idea is explored further in Action CCB.7.

If a building does not achieve the minimum BEPS threshold during the five-year compliance cycle, the owner can make improvements through an established plan, either via deep retrofit or incremental changes (Section 4.2.2.2), or pay an alternate compliance fee. Revenue from the fee should be funneled through the DCSEU toward incentives for improvements in other buildings.

With a self-reported dataset, third-party data quality verification will be paramount to ensuring that the data accurately reflect building characteristics and performance. If the data is to drive and inform policies and programs, it must be accurate, and the public must have confidence in its accuracy. Data reports must be complete, accurate, and timely – a daunting undertaking given the number of reports that DOEE already processes. Data quality verification may be

¹⁴⁴ The BEPS Task Force recommendations also included "disclosure of interval energy use." *Clean Energy DC* recommends that the District pursue a path to obtain interval energy use for all subject buildings via the utilities, similar to the Efficiency Vermont model. Further detail is available in Action EB.1

¹⁴⁵ New York City Retrofit Accelerator, <https://retrofitaccelerator.cityofnewyork.us/>

¹⁴⁶ HVAC is heating, ventilation, and air conditioning.

¹⁴⁷ Brian Merrill, "Operational Improvements Can Double Energy Efficiency Savings in Commercial Buildings," *BusinessWire*, February 6, 2013, <http://www.businesswire.com/news/home/20130206005559/en/Operational-Improvements-Double-Energy-Efficiency-Savings-Commercial>

contracted to a third-party firm (either by DOEE or by building owners themselves), or verification may be undertaken in-house by DOEE with dedicated funding for staff time spent on inspections and correspondence. Either option will require an ongoing stream of dedicated funding.

DOEE is commencing a final, more detailed analysis with support from C40 Cities Climate Leadership Group and Lawrence Berkeley National Laboratory. The results of this analysis should then be used to finalize program design and implementation.

Next Steps

- 1 Finalize the following BEPS design details as part of the analysis with C40 Cities Climate Leadership Group:
 - Minimum ENERGY STAR score thresholds
 - Included building types
 - Phased-in approach by building area
 - EUI improvements for the Performance Path
 - Action options under the Prescriptive Path
 - Enforcement procedures (including data validation)
 - Exemption requirements
 - Any accelerator program.
- 2 Design and implement a BEPS policy for public and private buildings in the District. Implement BEPS in 2019-2020, and ensure the District Government leads by example with its own buildings.
- 3 Investigate financial supports that can be provided for social housing developments and determine compliance plan requirements for any social housing developments seeking extensions.

EB.6 Drive energy efficiency at tenant build-out

Action: Provide incentives to encourage efficiency improvements upon tenant turnover and build-out.

Relevance: Lighting, controls, certain HVAC systems, and tenant-owned equipment (e.g., office/IT equipment, commercial kitchens) are routinely replaced at tenant turnover, and less frequently replaced at lease renewal. Many commercial tenant spaces, including office and retail, turn over an average of once every seven years. This makes tenant turnover a key opportunity to improve efficiency.

Details: Implement a multi-pronged strategy for maximizing efficiency gains during this unique window of opportunity, and consider programs to incentivize energy efficiency improvements at tenant build-out. Such programs could be modeled on successes in other states (e.g., Massachusetts). These should be simple, streamlined and predictable to help minimize costs and delays. Time is a key consideration at tenant build-out, when both landlords and tenants are typically eager to complete the process as quickly as possible.

Incentives should include simple set payments (e.g., \$0.30 per square foot) for pre-determined packages for each major commercial tenant type (e.g., specific lighting densities for office, retail, etc.) that push energy efficiency well below code-permitted levels. As energy modeling can be costly and time-consuming, the District Government should not require energy models to receive incentives.

Similarly, the DCRA should offer expedited permitting for tenant build-outs that exceed building code requirements. Packages should be updated to require higher levels of efficiency at least as often as the District updates its building energy codes. Unlike the expedited permitting written into the District's *Green Building Act of 2006*, the DCRA should not be required to provide permits during a specific period (e.g., 30 days). Rather, the DCRA should simply move recipients of expedited permitting to the front of the line. The DCSEU should also continue to work with the DCRA to achieve improved compliance with building energy codes at tenant build-out—a time when code compliance tends to be relatively low. Sub-metered tenants are significantly more likely to focus on efficiency at build-out (see Action EB.2 for additional detail). Lastly, federal law requires the EPA ENERGY STAR program develop and launch a new rating system for tenant spaces by 2020. The District and the DCSEU should recognize, train, market, and provide incentives to drive early tenant adoption of this new system as a cornerstone of tenant awareness and action to improve efficiency.

Next Steps

- 1 In 2019, begin to offer incentives for pre-determined packages of improvements through the DCSEU, and expedite permitting for tenant build-outs that include planned packages of equipment that exceed code.
- 2 Recognize, train, market, and incentivize early tenant adoption of EPA ENERGY STAR's rating system for tenants upon its launch.

EB.7 Encourage the adoption of green leases through education and training

Action: Encourage building owners and tenants to adopt green leases by providing stakeholder training, education, and recognition programs.

Relevance: Green leasing, or energy-aligned leasing, is the practice of realigning the financial incentives of the landlord and tenant to support energy or sustainability goals in the lease documents. These leases overcome the principal-agent problem, whereby landlords and tenants are dis-incentivized to undertake energy efficiency upgrades in a building, as neither realizes the full benefit of the upgrades.

Details: In a recent study, the Institute for Market Transformation (IMT) estimated that green leases could reduce energy consumption in U.S. office buildings by between 11% and 22%, reducing nationwide utility expenditures by commercial buildings by as much as \$0.51 per square foot. The potential savings for the U.S. market for leased offices ranges from \$1.7 billion to \$3.3 billion in annual cost savings.¹⁴⁸

The District should provide education and resources for stakeholders such as brokers, lawyers, and commercial real estate companies that are in a position to increase uptake of green leases, as well as building owners and tenants. This can be done via round-table discussions, or by providing training. The District should additionally recognize those leaders in the industry who participate in green leasing. The Green Lease Leaders program run by IMT and the DOE already recognizes these organizations; the District can encourage building owners and tenants to participate, and can provide recognition to those who do.

Next Steps

- 1 By 2019, offer a form of recognition for leading market participants who prioritize green leasing through a program such as the Green Lease Leaders.
- 2 In mid-2019, provide education and resources around green leasing to brokers, lawyers, commercial real estate companies, tenants and owners.

¹⁴⁸ Feierman, Andrew. What's in a Green Lease? Measuring the Potential Impact of Green Leases in the U.S. Office Sector. Institute for Market Transformation. May 2015. http://www.imt.org/uploads/resources/files/Green_Lease_Impact_Potential.pdf

EB.8 Develop a virtual energy audit program

Action: Establish a virtual energy audit program covering all building types in the District.

Relevance: Energy audits are a critical tool to understanding a building's current energy performance and improvement opportunities. To meet its GHG reduction targets, the District will be required to retrofit a large portion of the existing building stock. As such, it is critical for the District to find ways to conduct audits on many buildings citywide, in a short period of time, and with modest funding.

Details: There are two types of energy audits: traditional and virtual. A traditional energy audit requires the physical presence of a trained building analyst, and the associated time and resources. This approach provides the greatest opportunity for a building owner to identify issues and opportunities, but is also costlier. A virtual energy audit is a streamlined version of the traditional energy audit that uses energy and other building data, but does not require a trained building analyst to check building systems and identify issues and opportunities, and is thus much less expensive.

Chicago offers one example of a successful virtual energy audit program. Energy Impact Illinois' EnCompass is an online tool developed through a collaboration of the DOE, the Chicago Metropolitan Agency for Planning, and the private sector.¹⁴⁹ It uses existing ENERGY STAR or Energy Information Administration benchmarking data to extrapolate broad trends in retrofit needs and opportunities in large scale residential and office buildings.¹⁵⁰ By completing a survey on building characteristics and components, the program provides building owners with a customized list of high value energy conservation measures, and their potential impact on energy performance.

For substantially less effort and time, a virtual energy audit allows building owners to identify most of the key insights that a traditional audit would deliver. It can quickly focus on key issues that drive poor energy performance, allowing more time and resources to be spent addressing identified issues. They make energy audits accessible to a wider set of building owners that either cannot afford a traditional audit, or would not invest in one.

The District should establish a virtual energy audit program that is available and attractive to all building types. For such a program to be successful, it must include the following characteristics:

- Full cooperation from local utilities to access utility data.
- Data confidentiality.
- Pairing with recommendations for energy (and other) efficiency measures.
- A one-stop shop for homeowners that pairs audit recommendations with funding and incentives to make physical building improvements (see Action CCB.5).
- Easy availability to targeted customers (e.g., small business owners, homeowners, renters).
- Opt-In integration with regional multiple listing service website MRIS (for residential users).¹⁵¹

¹⁴⁹ <http://encompass.energyimpactillinois.org/>

¹⁵⁰ Energy Information Administration data comes from the Commercial Buildings Energy Consumption Survey (CBECS).

¹⁵¹ www.mris.com

Next Steps

- 1 Obtain approval for the use of customer utility data in a virtual energy audit program and develop agreements with utilities to access this data in 2018.
- 2 Secure funding, and then commission an organization to develop and manage an online virtual energy audit program by the end of 2018.
- 3 Aim to provide audit results to property owners in 2019.

4.2.3.3 ACTION ON DISTRICT GOVERNMENT BUILDINGS

EB.9 Lead by example in District Government operations

Action: Lead by example by implementing an aggressive deep energy retrofit program, followed by a net-zero retrofit program across the District Government building stock.

Relevance: Deep energy retrofits are building-specific, whole-building analyses designed to identify points in the building lifecycle where investments in energy efficiency can achieve the highest return. While the achievable savings depend on the building in question, the District can lead by example by pursuing the process for its own buildings, with targets for energy savings to guide its efforts.

The District has a legacy of leadership through complying with its own benchmarking ordinance and going further in publishing fifteen-minute interval data for all DGS buildings through the BuildSmartDC program. This underscores the importance and value of such actions and demonstrates a broader proof-of-concept for the building industry. The District should extend this leadership beyond energy disclosure and execute an action plan to reduce its building energy consumption via a deep energy retrofit program, followed by a net-zero retrofit program.

Details: DGS should phase in an aggressive governmental building retrofit program over time, beginning with a deep energy retrofit process that covers 9% of District Government-owned buildings by square footage between 2021 and 2024. The District Government should strive for an average of at least 30% reductions in energy and emissions, recognizing that that circumstances will vary by building, and different levels of reductions will be financially feasible and technically viable for different buildings. Following this initial sweep of deep energy retrofits, the District should initiate net-zero retrofits across 12.5% of the District Government building stock between 2026 and 2032. Achieving these two sets of retrofit targets will reduce District Government energy consumption by approximately 16%, with comparable reductions in energy costs and GHG emissions.¹⁵² The program should aim for a net-zero level of energy performance across the District Government-owned building stock.

¹⁵² The impact on energy costs and GHG emissions will depend on how much of the reductions originate with electricity versus natural gas.

In targeting these retrofit rates, the District Government should develop and implement a Strategic Energy Management Plan, as recommended below. In pushing the private sector to significantly improve building energy performance, the District Government can learn from and work with the U.S. General Services Administration in at least three ways:¹⁵³

- Identify specific leasing preferences related to GHG emissions, energy performance, and other sustainability issues.
- Incorporate the social cost of carbon into building-related decision-making.
- Use combined purchasing power to provide market signals to suppliers to offer low, zero, or negative carbon products.

Additionally, DGS should lead by example by entering its buildings in the compliance cycle for the Building Energy Performance Standard (BEPS) before privately-owned buildings, as detailed in Action EB.5.

Buildings should also be evaluated as potential participants or anchors for neighborhood-scale energy systems and microgrids, particularly when near new commercial developments or in conjunction with public infrastructure investments. Multifamily housing and school buildings may be particularly strong candidates.

Next Steps

- 1 In 2018, undertake and complete a strategic energy plan for reducing energy and water use across the DGS portfolio. (See action EB.10 for additional detail.)
- 2 Implement a deep energy retrofit program across 9% of the District Government building stock (by square footage) between 2021 and 2024, prioritizing those buildings whose core systems and equipment are nearing the end of their useful life. Target an average of 30% energy use reductions from these retrofits.
- 3 Implement a leadership-focused net-zero retrofit program across 12.5% of the District Government building stock between 2026 and 2032.

¹⁵³ Greening the District of Columbia: Incentives and Policies to Achieve Deep Green Building Construction and Renovations

EB.10 Develop and implement a Strategic Energy Management Plan for District Government buildings

Action: Develop a Strategic Energy Management Plan (SEMP) for District Government buildings managed by DGS that aligns with the District Government’s *Clean Energy DC* commitments and ensures the District Government continues to play a leadership role as climate and energy action increases and intensifies.

Relevance: Like private building owners and operators, the District Government has a responsibility to reduce its own contribution to climate change and the opportunity to reduce energy costs by strategically and persistently seeking and acting on opportunities to reduce energy costs and shift to zero-emission energy sources.

As discussed in other actions, the District Government also has an important leadership role to play, both in setting an example and in testing solutions, assessing their experiences, and sharing lessons with local stakeholders, as well as using lessons learned to better shape and design programs, policies, and incentives. Examples in *Clean Energy DC* include implementing the Building Energy Performance Standard and conducting deep energy and net-zero ready retrofits earlier than in private buildings.

Details: Strategic energy management is a focused, long-term approach to reducing energy use through efficiency and conservation, as well as taking other steps to reduce costs and GHG emissions. The District Government has been actively working to reduce energy and emissions for several years. For example, the DGS manages BuildSmart DC, an online platform receiving energy data from tens of thousands of data points every day, which allows users to review basic and detailed energy use data on more than 400 District Government buildings.¹⁵⁴ DGS already sources 100% of its electricity from renewable sources through power purchase agreements and renewable energy certificates.

The SEMP should establish DGS’s ongoing approach to persistently identifying, assessing, prioritizing, and implementing energy and GHG reduction measures. It should specify any guiding policies, clarify roles and responsibilities, codify the methods used to evaluate potential opportunities, and identify and begin to resolve any organizational barriers. BuildSmart DC provides a wealth of data to build upon, and energy audits conducted in most DGS buildings in 2011 likely offer a preliminary set of actions to consider.¹⁵⁵

The SEMP should align with the scale of action called for in the balance of this report, particularly in regard to a set of deep energy retrofits. It should act as a roadmap to ultimately drive District Government buildings towards net-zero-ready performance levels.

¹⁵⁴ <http://www.buildsmartdc.com>

¹⁵⁵ <https://dgs.dc.gov/page/energy-efficiency-0>

Next Steps

- 1 In 2018, collect all existing policies, plans, audit results, and similar documentation; assemble data on current and historical performance; and investigate and summarize the current processes that identify, analyze, and act upon reduction opportunities—including who is involved and any challenges they may be facing.
- 2 Once completed, DGS should develop a SEMP (with the contents described above). Focus on establishing the organizational structure(s), policies, processes, and tools necessary to maintain continuous action, and ensure they are adequately resourced and supported by leadership.



4.2.4 EXISTING BUILDINGS ROADMAP

	FIVE-YEAR OUTLOOK					PROJECTED PATH TO 2032 CLIMATE AND ENERGY TARGETS										
	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
EXISTING BUILDING ROADMAP																
EB.1 Increase access to building energy performance data for energy efficiency programs																
EB.2 Increase DCSEU flexibility																
EB.3 Provide the incentives necessary to operate a District-wide deep energy retrofit program																
EB.4 Coordinate and centrally track District efficiency and finance programs																
EB.5 Implement a Building Energy Performance Standard																
EB.6 Drive energy efficiency at tenant build-out																
EB.7 Encourage the adoption of green leases through education and training																
EB.8 Develop a virtual energy audit program																
EB.9 Lead by example in District Government operations																
EB.10 Develop and implement a Strategic Energy Management Plan for District Government buildings																

	Planning, Research, and Program and Policy Development		Pilot Project
	Plan or Program Implementation		Program Evaluation
	Policy or Regulation Implementation		

4.3 CROSS-CUTTING BUILDING ACTIONS

In addition to the actions above, the District should take steps to support energy use and GHG emissions reductions across the overall building sector. The actions recommended below target both New Construction and Existing Buildings.

4.3.1 RECOMMENDED ACTIONS

4.3.1.1 INCREASING AND IMPROVING ACCESS TO FUNDING AND FINANCING

CCB.1 Establish a Green Bank and increase other funding for energy efficiency and renewable energy projects in new and existing buildings

Action: Increase the funding provided for energy efficiency and renewable energy projects in the District, including but not limited to creating a Green Bank and increasing funding for the DCSEU.

Relevance: The first approach to funding the District's energy transition should be the creation of a Green Bank. Such an institution can support not only building energy efficiency, but also renewable energy development. Green banks are typically public or quasi-public entities that leverage private sector capital to increase the overall level of investment in renewable, low-carbon energy. The creation of a Green Bank is essential to meeting the District's targets, as the investments required to carry out the actions outlined in the Plan will far exceed what the District Government alone can provide.

As an illustration, DOE reported that a total of \$1.5 billion was required to meet the District's former requirements for solar energy generation.¹⁵⁶ As the District has now doubled its requirements for solar energy generation, even greater investment will be needed. The value and importance of a Green Bank has been echoed by DOE's Single Family and Small Multifamily Working Group in its August 2016 report, *Green Residential Solutions – Recommendations from the Single Family Small Multifamily Green Building Working Group*. Green banks have proven to be a crucial model for providing much-needed funding for the many dimensions of energy transition, while providing additional benefits for consumers, businesses, and investors. These include:

- Improved leveraging of private sector investment per public dollar spent.
- Continued financing of public grants with a lower public funding burden.
- Lower energy bills through efficiency and renewable energy.
- Job growth in the local economy through clean energy investments.
- Streamlining existing programs without having to consolidate program administration.
- Improved efficiency of government programs by coordinating Green Bank activities with other agencies to maximize program value.

¹⁵⁶ District of Columbia Green Bank Recommendations and Implementation Plan, Department of Energy & Environment, Prepared by the Coalition for Green Capital, June 27, 2016

While a Green Bank can offer larger loans, credit enhancement, loan loss reserves, and other financial tools, there remains a strong place for more traditional incentive/grant programs such as those operated the DC Sustainable Energy Utility. The DCSEU has made great strides in reducing energy use, but the level of funding for the DCSEU falls short of funding levels of peer organizations that have achieved savings comparable with the DCSEU's performance benchmarks. To bring funding in line with similar leading-edge efficiency programs in the U.S. and help achieve District's emissions reduction targets, the District should consider increasing the funding it receives from the SETF or other sources.

Details: The DOEE commissioned an analysis of the potential benefits and design of a Green Bank in the District, resulting in the *District of Columbia Green Bank Technical Report*.¹⁵⁷ The principal recommendations from this report include:

- Pass the "Green Finance Authority Establishment Act of 2017," introduced by Mayor Bowser to establish the Green Bank as a new quasi-public, wholly-owned nonprofit corporation of the District Government (District Instrumentality) that sits between the government and markets.
- Establish a Board of Directors appointed by the Mayor. Hire a team of dedicated staff to operate the Green Bank with expertise in investing in clean energy.
- Capitalize the Green Bank with up to \$100 million of public money over time, to animate approximately \$500 million in private investment.
- Provide an ongoing stream of dedicated public funding to a Green Bank on an annual basis.
- Use the Green Bank to provide a portfolio of financing and market-based solutions that target renewable energy, energy efficiency, and low- to zero-emission transportation.
- Give the Green Bank the ability to issue bonds under various structures.
- Target specific funds to single family and multifamily buildings as well as low-to-moderate income individuals and combine these funds with other instruments (e.g., on-bill financing).
- Explore options to include the affordable housing community in providing input to decisions made by the Green Bank, and on establishing other funding initiatives.

The DC Green Bank should build on existing District tools for financing energy improvements, including DOEE's privately administered Property Assessed Clean Energy (PACE) financing program (discussed further in Action CCB.2), a government-enabled, tax-based financing tool that drives private capital into publicly beneficial projects that reduce energy use, improve infrastructure, and better the District's built environment. In addition, the District Government has many tools such as revenue bonds, private activity bonds, and affordable housing preservation funds that could be streamlined to maximize low carbon investment in collaboration with other District agencies. Making clean and efficient energy technology cheaper and readily attainable is a crucial component of transforming the District's energy usage. In addition to providing a mechanism to reduce carbon emissions, low-cost and long-term financing for energy efficiency and clean energy improvement projects are an important strategy to use public sector resources to drive private sector investment into the local economy—especially underserved communities. This saves businesses and residents money, and creates local jobs for contractors and building service providers.

To effectively drive the levels of investment required to achieve the District's emissions reduction targets, the DC Green Bank should offer a portfolio of financing solutions that address both renewable energy and energy efficiency market needs. These solutions can include:

¹⁵⁷ *Greening the District of Columbia: Incentives and Policies to Achieve Deep Green Building Construction and Renovations*

- PACE financing and incentives to accelerate renewable energy use and deep energy efficiency retrofits.
- On-bill financing to open the energy efficiency market to renters.
- Low-to-moderate income whole-home solutions with alternative underwriting options.
- Standard offer loan loss reserve to drive residential lending.
- Comprehensive community solar solutions, including rooftop aggregation, to increase solar access.
- Aggregation of solar renewable energy certificates to overcome inefficiency.¹⁵⁸

The primary current source of funds for energy efficiency work in the District is the Sustainable Energy Trust Fund (SETF). The SETF currently collects approximately \$21 million annually through surcharges on customer bills, most of which funds the DCSEU programs. The SETF surcharge has been fixed at \$0.01505 per therm consumed of natural gas and \$0.001612 per kWh consumed of electricity, as of Fiscal Year 2017 (this represents an 8% increase over the rate in 2016 and prior years).¹⁵⁹ When converted to standard units (MMBtu), these surcharges reflect a significant gap between what is charged for the consumption of natural gas (\$0.1505 per MMBtu of natural gas) and what is charged for electricity (\$0.473 per MMBtu of electricity)—the natural gas rate is approximately 30% of the electric rate. (There is a second surcharge, the Energy Assistance Trust Fund (EATF), which helps fund low-income energy assistance, is weighted more heavily towards gas bills. However, the magnitude of the EATF surcharge is less, so the two do not cancel out.) Moreover, as District-wide energy use drops, the funds collected by the SETF will decrease as well, limiting the work the DCSEU will be able to undertake—though this may be addressed through legislation. Given the differences between natural gas and electric markets and efficiency opportunities and the greater total source energy footprint of electricity when accounting for generation loss, some divergence is likely appropriate. However, the size of the divergence should be examined.

Moreover, the District's goals for energy efficiency savings through the DCSEU and related programs place it among the savings achieved by leading programs in the United States. The DCSEU is charged with performance goals of reducing electricity and natural gas consumption by an amount approximately equal to 1% of citywide consumption, per year. Yet, as detailed in Table 5 and Table 6 below, excerpted from the American Council for an Energy-Efficiency Economy's 2014 state scorecard, the District's funding for the DCSEU is a fraction of what is being expended in these other states, measured per unit of revenues or per customer. As the tables also indicate, DCSEU spends less per unit of energy savings than some of these other programs. This reflects the DCSEU's efficiency, but also the fact that the program is relatively young, and that the measures it is investing in to date are relatively shallow. As Demand-Side Management energy efficiency programs mature, they typically see declining savings per dollar spent, as the lowest-hanging fruit are addressed. Deeper measures cost more upfront, but because of their longer lifetime of savings, still compare well in their levelized cost of energy.¹⁶⁰ One must also remember that the DCSEU's underlying policy goals and contractual requirements are generally more expansive than in other jurisdictions.¹⁶¹

¹⁵⁸ For more details on these, see the District of Columbia Green Bank Technical Report, https://doee.dc.gov/sites/default/files/dc/sites/ddoe/service_content/attachments/20170403_Green%20Bank%20Technical%20Report%20for%20DOEE_FINAL.pdf.

¹⁵⁹ D.C. Official Code § 8–1774.10(b).

¹⁶⁰ "How much does efficiency cost?" ACEEE, <https://aceee.org/sites/default/files/cost-of-ee.pdf>.

¹⁶¹ TetraTech, Department of Energy and Environment Verification of the District of Columbia Sustainable Energy Utility FY16 Annual Evaluation Report for the Performance Benchmarks, June 28, 2017. Page 6. https://doee.dc.gov/sites/default/files/dc/sites/ddoe/publication/attachments/EMV_DCSEU_FY2016_Annual_Performance_Benchmarks_finaldraft.pdf.

State	2016 Spending on Energy Efficiency Programs (percent of electric utility revenues)	2016 Savings from Electric Efficiency Programs (net incremental electric savings achieved as a percent of retail sales)	Rank among states in 2016 electricity savings	Acquisition costs (\$ spend per MWH of savings) ¹⁶²
Massachusetts	6.25%	3.00%	1	\$343.32
Rhode Island	6.42%	2.85%	2	\$365.79
Vermont	6.84%	2.52%	3	\$390.40
Illinois	2.05%	1.23%	11	\$153.07
New York	2.00%	1.09%	15	\$265.77
Maryland	2.49%	0.91%	17	\$333.20
District of Columbia	0.96%	0.65%	23	\$176.13

↑ **Table 5.** Spending and savings on energy efficiency in electricity in selected top states, Maryland, and the District, 2016¹⁶³

State	2015 Spending on Energy Efficiency Programs (dollars per residential customer)	2015 Savings from Natural Gas Efficiency Programs (net incremental gas savings achieved as a percent of retail sales)	Rank among states in 2016 natural gas savings	Acquisition Costs (\$ spent per therm of savings) ¹⁶⁴
Minnesota	\$35.94	1.40%	1	\$1.76
Rhode Island	\$104.09	1.26%	2	\$5.89
Massachusetts	\$136.52	1.13%	3	\$7.39
Michigan	\$24.95	1.05%	4	\$1.55
Vermont	\$63.73	0.75%	10	\$3.68
District of Columbia	\$36.95	0.33%	22	\$5.19
Maryland	\$14.37	0.10%	30	\$9.88

↑ **Table 6.** Spending and savings on energy efficiency in natural gas in selected top states, Maryland, and the District, 2016¹⁶⁵

Furthermore, as a part of their annual evaluation, measurement and verification process of the DCSEU's programs, consulting firm TetraTech analyzed the funding that would be required for the DCSEU to achieve its maximum performance targets in electricity and natural gas savings.¹⁶⁶ Under the new \$100 million, 5-year contract, DCSEU is charged with achieving electricity savings over five years equivalent to 5% of the 2014 electricity consumption of the District of Columbia, and natural gas savings over five years equivalent to 3% of the 2014

¹⁶² DOEE calculated this column. The levelized cost of saved energy would be a better comparison metric, but could not be calculated with the data available.

¹⁶³ ACEEE Spending/Savings Tables, 2016. <http://database.aceee.org/sites/default/files/docs/spending-savings-tables.pdf>

¹⁶⁴ DOEE calculated this column. The levelized cost of saved energy would be a better comparison metric, but could not be calculated with the data available.

¹⁶⁵ ACEEE Spending/Savings Tables, 2016. <http://database.aceee.org/sites/default/files/docs/spending-savings-tables.pdf>

¹⁶⁶ TetraTech 2016. Pages 7-11

natural gas consumption of the District of Columbia. Based on the three-year average of the acquisition costs—that is, the amount of money that is spent for one unit of verified energy savings—from 2014 through 2016, one can estimate how much budget would be needed to achieve the five-year maximum savings. If the acquisition costs for the DCSEU were equivalent to the three year historic average, DCSEU would need a five-year budget of \$158 million, including \$115 million for electric programs and \$42 million for natural gas programs.

It should be noted that the DCSEU's self-reported FY 2017 results are better than past years—achieving the maximum gas and electric savings for the first time.¹⁶⁷ If the DCSEU were able to continue to get the same savings per dollar for both electric and natural gas that they were able to achieve in 2017, they would need at least \$111 million to achieve their maximum targets. However, those results had not yet been verified by third-party contractor at the time of the publication of this report.

Nor, as already stated, should one assume that costs will stay flat or continue to decline. ACEEE analysis of savings over time across jurisdictions suggests that, generally, acquisition costs decline over the first five to six years of implementation, and then begin to increase as the portfolio matures—as the “low hanging fruit” of low/no cost measures are completed, and incremental savings require more expensive measures to achieve, such as capital improvements and deep energy retrofits.¹⁶⁸ This negative feedback loop has led other jurisdictions with more established demand-side management programs to increase their surcharge over time.¹⁶⁹ A similar approach taken by the District Government would ensure the continued funding necessary for the successful operation of the DCSEU.

It is not necessary to run all energy efficiency programs and renewable energy programs through a single entity, nor fund them through a single source. What matters is that residential and commercial consumers see a single unified brand, web presence, and meet their needs with a simplified intake and concierge service—as detailed in other recommendations, including CCB.5 and CRE.4.

To meet its goals, the District Government should consider whether the best approach is to provide more funding to the DCSEU directly or through other avenues, whether to increase the SETF, and what alternate funding streams may be available.

Next Steps

- 1 Establish the DC Green Bank as an independent instrumentality of the District Government that sits between the government and markets. Capitalize the DC Green Bank with up to \$100 million of public money over time and from several sources to unlock approximately \$500 million in private investment.
- 2 Adjust SETF rates for electricity and natural gas to better align them with a funding allocation that allows the DCSEU to operate at the leading edge of energy efficiency programs in the country. The adjusted rate should account for the additional funding needed to achieve more aggressive goals and the diminishing returns this funding may achieve over time.

¹⁶⁷ “2017 Annual Report: Building the Future of Energy in the District,” *DC Sustainable Energy Utility*, 2017. Forthcoming.

¹⁶⁸ An Empirical Model for Predicting Electric Energy Efficiency Resource Acquisition Costs in North America: Analysis and Application, John Plunkett, Theodore Love, and Francis Wyatt, Green Energy Economics Group, Inc., 2012. <http://www.aceee.org/files/proceedings/2012/data/papers/0193-000170.pdf>.

¹⁶⁹ TetraTech 2016

CCB.2 Enhance the District's Property Assessed Clean Energy financing program

Action: Expand the District's existing Property Assessed Clean Energy (PACE) Commercial financing program and explore implementation of a PACE Residential program to cover the residential building market.

Relevance: PACE is a financing structure that funds cost-saving measures through a special property tax assessment. Through the PACE program, building owners can secure 100% financing for qualifying energy efficiency retrofits and renewable energy investments, and other types of projects. Terms of repayment can be up to 20 years, which is much longer than conventional financing. Loans are paid twice yearly on property taxes rather than monthly like traditional loans, and remain with the property when it is sold. As such, PACE offers property owners the opportunity to immediately improve a property's cash flows through an energy-focused investment, and provide property owners with lower utility bills, enhanced property values, and improved building maintenance, resident comfort, health, and resiliency. Further, because PACE only uses the District's tax collection authority to enhance private capital investment, it requires no direct funding. This makes PACE an attractive and effective financing mechanism that can increase the private investment necessary to achieve the District's 2032 climate and energy targets.

Details: The District's current PACE program (DC PACE) serves only commercial building owners, including some multifamily buildings. Much work remains to scale the use of Commercial PACE as a financial product within the local real estate market. DC PACE has committed to driving down interest rates further through market competition among private lenders. DC PACE is also working to better serve community-based organizations, such as locally-owned and disadvantaged small businesses, nonprofits and public service institutions, affordable housing, and houses of worship, which frequently have difficulty accessing solar and energy efficiency. As noted in recommendations in the chapter, a key component of scaling DC PACE will also be achieved through closer integration of DC PACE with the DCSEU and other District programs to link financing solutions to ongoing grants, incentives, data management tools, technical assistance, and marketing programs. The DCSEU's ability to develop and manage building level analytics should be integrated closely into DC PACE underwriting and approval processes to reduce total program costs and streamline the customer experience.

Moreover, PACE could be expanded to serve the entire residential market, including single-family homes. Expanding PACE, with robust consumer protections, to serve the entire residential market will increase the number of property owners that can access this financing program, and thus the proportion of the District's energy use and GHG emissions that can be targeted with lower cost renewable energy and energy efficiency actions in the residential sector. DOEE's Single-Family and Small Multifamily Working Group identified a set of recommendations for a residential PACE program:

- Coordinate with major financial institutions to overcome barriers related to subordinated debt.¹⁷⁰
- Create an interest buy-down program for low- and moderate-income households to enhance utility savings.
- Partner with the DCSEU to create greater value to residential customers.

¹⁷⁰ Subordinated debt is debt that ranks below other loans and securities with regard to claims on assets or earnings. In the case of borrower default, creditors who own subordinated debt will not be paid until more senior debtholders are paid in full.

- Create market demand through a strong marketing and outreach strategy, led by DOEE and a residential PACE administrator, in partnership with the District's financial and real estate community to create a pipeline of projects.¹⁷¹

Furthermore, the Working Group recommended that the District follow the residential PACE guidance released by the U.S. Department of Housing and Urban Development's (HUD) Federal Housing Administration (FHA) in July 2016.¹⁷² The new FHA guidance is the first signal of support for PACE at the federal level and aligns with the District's current PACE program. The guidance provided is intended to take the perceived risk out of this investment mechanism, thereby significantly increasing the availability of affordable clean energy financing to homeowners.

In addition to the Working Group recommendations, the District should look to other successful residential PACE programs operating in other cities and consider adopting a greater variety of financing options, including unsecured financing and financial incentives provided at point of sale. The District Government should also give tenants of residential buildings the option to finance energy efficiency upgrades in smaller installations, rather than financing a large upgrade with multiple energy efficiency improvements.

The District Government can implement a residential PACE program without any additional legislative action. The *Energy Efficiency Financing Act of 2010*, the enabling legislation for the DC PACE financing program, provides the authority necessary to originate and administer both commercial and/or residential PACE programs. In addition, the existing DC PACE administrator has been procured to establish and administer a District PACE financing program, whether such a program serves commercial or residential customers. Furthermore, the current PACE legal instruments and collection mechanisms that have already been established to serve the commercial PACE properties can be adapted to serve residential PACE assessments with little to no modification. Therefore, the core mechanisms for the establishment of a new District residential PACE program are already in place.

Next Steps

- 1 As part of the establishment of the DC Green Bank, investigate ways to expand the current DC PACE program to cover all residential building owners with robust consumer protections. Explore options and look to other case studies of PACE to provide a variety of energy efficiency upgrade financing options.
- 2 Issue a "standard offer" to commercial lenders and PACE originators to increase market competition among capital providers to the DC PACE program.
- 3 DOEE and DCSEU should provide pre-development support incentives and funding and subsidized energy audits that will overcome the upfront capital requirements for subsequent financing of energy efficiency and renewable energy projects.
- 4 DOEE should develop specific guidance on the use of Green Bank financing programs with other DC government finance programs and incentives, including coordinated underwriting and pre-qualification for PACE and Low Income Housing Tax Credits (LIHTC) by DCHFA and DHCD, and issuance of tax exempt financing through the District's revenue bond program.

¹⁷¹ Green Residential Solutions – Recommendations from the Single Family Small Multifamily Green Building Working Group, June 2016.

¹⁷² Available at <http://portal.hud.gov/hudportal/documents/huddoc?id=16-11ml.pdf>.

4.3.1.2 POLICY AND PROGRAM RECOMMENDATIONS

CCB.3 Ensure code compliance in all buildings through increased investment in robust code enforcement

Action: Ensure code compliance in both new and existing buildings through increased investment in energy and green code enforcement and education.

Relevance: Even though states and cities across the nation are adopting increasingly stringent energy and green codes, overall code compliance rates remains low. This is often the result of a combination of factors such as insufficient financial investment in the energy code enforcement program, lack of trained staff dedicated solely to energy and green code enforcement, lack of political support for tough enforcement, and a local building industry that has not yet caught up to speed and been educated on the new, more complex codes.

The District has taken many steps over the past five years to address these challenges beginning with the establishment of the Green Building Division at the Department of Consumer and Regulatory Affairs (DCRA). Before the Division was created, the District had similar code compliance rates to the rest of the nation as demonstrated by a code compliance study conducted by DCRA in partnership with the DCSEU and Institute for Market Transformation (IMT) in 2014. In a follow-up study completed two years later, it was shown that DCRA had vastly improved compliance, specifically at plan review. DCRA's achievements in improving energy code compliance were recognized in 2015 when it was awarded the national Standard Bearer's Award by IMT and the International Code Council, recognizing their innovation and leadership in energy code enforcement.

Even though DCRA has made great strides in developing a robust energy and green code enforcement program, to achieve and maintain the building performance required to achieve the District's 2032 targets, the District Government will need to increase staff and set specific compliance targets.

Details: To improve code compliance in new and existing buildings, the District Government should increase financial investment in the Green Building Division through the Green Building Fund¹⁷³, hire and train additional staff at DCRA, develop and administer an incentivized, voluntary above-code net-zero programs for both residential and commercial buildings, develop and invest in new tools and resources for the building industry to help streamline and ease compliance, and train the building industry on new progressive codes. To support low-income and affordable housing developments and ensure the transition to net-zero energy codes are accessible for all income groups, the District should provide robust, tiered incentives based on average median income (AMI) in the form of structural incentives (expedited permitting and design support) as well as financial incentives that facilitate design and construction as well as award proven building performance.

¹⁷³ The Green Building Fund is a special purpose revenue fund established by the DC Green Building Act of 2006

Next Steps

- 1 Every two to three years, DCRA should undertake an energy code compliance study to understand the current state of compliance in the District and set strategic goals to improve performance. The previous two studies were completed in 2014 and 2016. Reports should be made public and transparent.
- 2 Develop and administer incentivized voluntary above-code net-zero programs for both residential and commercial buildings.
- 3 The District Government should invest additional financial resources in code enforcement by increasing revenue brought in by the DC Green Fund, established under the Green Building Act of 2006.
- 4 The DCRA Green Building Division in partnership with DOEE should lead the Energy Code and Green Code Technical Advisory Groups during the code development and adoption cycles to ensure that the proposed codes meet the goals and are enforceable.
- 5 Each year, DCRA and DCSEU should partner to develop and deploy a training curriculum on codes and code compliance that complements the training they already offer, and should continue to update the curriculum to support new codes and more ambitious targets.

CCB.4 Incentivize and require submetering

Action: Phase submetering requirements for new construction and major renovations into District Government building codes. Change District laws and regulations to allow residential building owners to submeter residential tenants for billing purposes.

Relevance: The energy used by tenants within their spaces can amount to up to 50% of the energy consumed in typical commercial office buildings.^{174,175} In commercial, multi-tenant buildings with a single or master meter, tenants are typically charged on a per-square-foot basis, and have limited or no visibility on their actual energy consumption. A recent U.S. DOE report highlighted the importance of submetering in reducing market barriers such as poor information availability and misaligned incentives between tenants and landlords.¹⁷⁶ Submetering these spaces and requiring building owners to inform tenants about their energy consumption gives tenants the information they need to track and reduce consumption.

While submetering alone does not reduce energy consumption, it provides a window into a building's tenant- and system-level energy consumption, and allows market actors to make informed operational and capital-investment decisions. Research by commercial real estate practitioners indicates that submetering tenant spaces can contribute to reducing building energy costs by more than 20%. Residential submetering also allows residents to capture the benefits of more efficient behavior and appliances.

¹⁷⁴ Base building systems such as heating and cooling, common area lighting, and elevator operations make up the other portion of commercial building energy use.

¹⁷⁵ U.S. Department of Energy, Office of Energy Efficiency & Renewable Energy. Energy Efficiency in Separate Tenant Spaces – A Feasibility Study. April 2016. http://energy.gov/sites/prod/files/2016/04/130/DOE%20-%20Energy%20Efficiency%20in%20Separate%20Tenant%20Spaces_0.pdf (p.1)

¹⁷⁶ Ibid.

It should be noted that this action can be particularly sensitive—and important—for affordable housing. As buildings increase in their efficiency toward net-zero energy levels of performance, developers of affordable housing must be able to provide a reduced utility allowance and proportionally increase the rent. However, the District should ensure that the net level of affordability for the tenant remains the same.

Details: The District should take several steps to phase in incentives and later requirements related to submetering to secure the energy saving-benefits of submetering. The following sequence will ensure that adequate infrastructure is in place and that owners will have sufficient time to prepare for and respond to requirements.

First, submetering should be added to the list of equipment that the DCSEU is able to incentivize. Currently, standard rebates are only available for certain types of equipment, such as lighting, HVAC, refrigeration, and food service, among others. To reduce the upfront cost of installing submeters, incentives should be expanded to potentially include hardware and installation costs for installing submeters. In addition, the DCSEU should provide training to building contractors, designers, and operators on the purpose, installation and use of submeters to promote energy efficiency as part of a broader set of operational-focused training offerings. As discussed in Action EB.2, the DCSEU should receive credit for any energy use reductions associated with such operational training programs, pending an appropriate methodology to account for savings. The District's building codes should also include submetering requirements for new construction and renovation. This will ensure that all newly constructed and renovated spaces will be submetered, and will phase-in submetering over time with the construction and renovation cycle.

Once a broader market share for submetering is established, the District should investigate a submetering policy similar to New York City's Local Law 88. Along with requirements for lighting upgrades in large non-residential buildings, LL88 includes a provision that requires non-residential building owners to install electric submeters for their non-residential tenants, providing monthly energy statements to those tenants.¹⁷⁷

The District of Columbia Code §34-1552 et seq. already requires the Commission to announce rules and standards for building owners of nonresidential buildings to install submetering infrastructure for the purposes of billing tenants for their share of energy consumption.¹⁷⁸ By omission, residential units are not included in this code. To realize the energy-saving benefits of submetering in residential spaces, the District Government should therefore legalize and regulate the practice of submetering in residential buildings. Coordination with OPC and the Office of the Tenant Advocate will be needed to enable residential submetering for billing purposes. For rent-controlled buildings, the District Government should work with tenants and landlords to devise and pass legislation to enact a fair and streamlined system of automatically lowering rents when tenants begin to assume utility costs previously born by the landlord.

¹⁷⁷ New York City Mayor's Office of Sustainability, Local Law 88, <http://www.nyc.gov/html/gbee/html/plan/ll88.shtml>.

¹⁷⁸ National Conference of State Legislatures, Utility Submetering, <http://www.ncsl.org/research/energy/utility-submetering.aspx>

Next Steps

- 1 Work with the DCSEU to include submeters as qualifying equipment for incentives, and offer submetering training to building contractors, designers and operators within the District as part of its educational curriculum. Pending the identification of an appropriate methodology, credit the DCSEU with energy use reductions associated with these sorts of training programs.
- 2 As part of the next building code update, require submetering at new construction and major renovations for non-residential buildings, and include the latest national model codes and standards.
- 3 By 2018, petition the Public Service Commission to open a formal case to consider changing its regulations to allow for submetering and billing in residential spaces, or introduce legislation to do so, while also regulating the interaction of submeter rates and rent increases so as to preserve housing affordability.
- 4 Work with industry to investigate, and if appropriate, enact a new law that requires tenant spaces in large new buildings to be submetered or separately metered.

CCB.5 Develop a centralized online platform for residential energy efficiency programs

Action: Create a centralized online platform to provide information on and access to residential energy efficiency programs. Provide resources and information on program offerings, available incentives and financing, and any other useful information for residents, multifamily building owners, and developers.

Relevance: This recommendation provided educational and informational resources to facilitate the process of accessing and paying for energy efficiency improvements. The District already offers several incentives and programs to make residential energy efficiency actions more accessible and affordable, with additional actions recommended in the Plan. A central resource that provides information on all available programs will increase the value and use of these incentives and programs by making them easier to access and understand. This will, in turn, help the District leverage its program investments and generate more private investment in the actions required to achieve its climate and energy targets.

Details: The creation of a single online platform for residential building owners will make it easier for residents, multifamily building owners, and developers to learn about and access energy efficiency programs, incentives, and financing offered by the District. A flexible, commerce-focused resource should be integrated with other building-related resources and incentives to provide a complete package of information, simplifying the process of investing in residential energy efficiency improvement and renewable energy installations.

This platform should be integrated with the DCSEU's existing energy efficiency website.¹⁷⁹ The DCSEU site provides both information and the means to solicit additional information either by phone, online chat, or email. Additional existing DOEE and Department of Housing and Community Development (DHCD) programs that should be integrated include:

- DOEE Weatherization
- DOEE Low Income Home Energy Assistance Program
- DOEE/DCSEU Solar for All Program
- DOEE Healthy Homes Program
- DOEE RiverSmart Homes/Communities
- DHCD Single Family Residential Rehabilitation Program
- DOEE and DHCD Lead Safe Program
- DHCD Home Purchase Assistance Program
- DHCD Employee Assisted Housing Program

To minimize barriers to adoption, the site should be made as intuitive as possible, and the District should ensure the content is accessible to those without regular internet access. To make it intuitive, a first step would be to create three separate entry points for the three main targets: residents, multifamily building owners, and developers. Separating the portal into spaces targeting each of these specific groups will improve the likelihood that users stay on the site and take action on the information and programs. To improve accessibility for low-to-middle income families and communities, the District should partner with trusted community organizations to help disseminate information to all neighborhoods and communities.

Given their mandate and experience managing their existing energy efficiency website, the DCSEU may be the ideal body for the coordination of this platform. Management could also be coordinated by a similar third party organization, or even the District itself.

Next Steps

- 1 Contact jurisdictions with similar online platforms to derive insights on the use, perceived effectiveness, and administrative costs of these initiatives in early 2018.
- 2 Determine the costs associated with website design, maintenance, and content development, as well as any staff time required in 2018.
- 3 Direct the DCSEU to expand their existing website to include other residential building-focused programs in the District and provide separate platforms for different audiences, or contract a separate arms-length organization to develop the site in 2018.
- 4 Launch the website by 2019.
- 5 Partner with trusted community organizations to help disseminate information to all neighborhoods and communities, including through offline platforms.

¹⁷⁹ <https://www.dcseu.com>

4.3.1.3 EDUCATION AND TRAINING

CCB.6 Maintain an ongoing outreach program to foster and expand awareness, education, and opportunities for collaborating around high-performance buildings

Action: Collaborate with local organizations to deliver awareness and educational programs to inform the public and promote highly efficient and net-zero energy buildings.

Relevance: Awareness and education initiatives can take multiple forms and target multiple audiences. The following were identified as most impactful and together speak to a broad audience.

1. Develop an energy educational series. The District should consider hosting multiple series with different topics for different audiences. As cost can be a barrier to entry for such classes, the District should explore options to underwrite the class and/or ensure basic provider costs are met to improve attendance and popularity. Potential topics could include the basics of net-zero energy, net-zero energy case studies, next generation technologies, and maximizing passive and active energy opportunities.
2. Partner with a local organization to provide additional content on net-zero energy technologies, design, and examples as part of an effort to expand existing energy conferences to provide additional focus on net-zero energy buildings. Select a local organization that has experience developing educational materials on building energy management and operations in the past. To host a large conference on net-zero and deep energy efficiency, the District should work with a partner to hold a single day symposium on energy innovation.
3. Sponsor local and international tours of examples of deep energy efficiency and community energy provision best practices. A working model for this recommendation can be found in the energy and green building tours provided by i-SUSTAIN. While the District may wish to lead its own tours, it should also consider contracting or partnering with organizations such as i-SUSTAIN. Some examples of local and international destinations for tours include the SEED classroom at the Mary McLeod Bethune Day Academy Public Charter School, the Chesapeake Bay Foundation Brock Environmental Center, the Omega Center, and the Phipps Conservatory.
4. Collaborate with local organizations to co-sponsor and organize in-depth tours and energy events at new and remodeled net-zero homes and small businesses. The District should partner with local groups to create a Buildings of the Future open house series in the following categories: Single Family Home, Multifamily Buildings, Offices, Retail Stores and Restaurants. Partnering with another organization can help distribute costs and responsibilities of this program. The District should ensure that the content in these educational tours include education on the various renewable energy options. This will help facilitate informed-decision making by residents in the District. For example, differentiating between electricity needs and heating energy needs, their associated costs, and options for each, can help residents make the best choice in choosing an energy provider or financing package for their needs.

To boost attendance in energy education sessions, the District should also utilize and strengthen existing partnerships with local professional organizations, such as the District of Columbia Building Industry Association, the Apartment and Office Building Association of Metropolitan Washington, the Urban Land Institute Washington, National Capital Region chapter of the U.S. Green Building Council, the American Institute of Architects, the International Living Future Institute's DC Collaborative, and the local ASHRAE chapters.

Next Steps

- 1 Create a high-performance building and net-zero energy series. Establish an education and marketing partnership in 2018, and begin holding the series in 2019.
- 2 As part of building local partnerships, organize one of the regional tours listed above.
- 3 Consider arranging a visit by key staff to Brussels and Sweden as a way of learning first-hand about experiences in building code acceleration.
- 4 Approach local organizations to create a conference partnership in 2018, targeting an expanded conference in late 2018, or 2019.
- 5 In mid-2018, investigate potential partners and avenues for a Buildings of the Future tour.

CCB.7 Partner to support training and certification of building contractors and managers

Action: Partner with HVAC and envelope/siding subcontracting unions and trade associations to prepare for a transition to heat pump based systems and high-performance envelopes. Support the creation of a job skills program focused on next-generation building technologies.

Relevance: Contractors and fabricators have highly refined production techniques, and often have little capacity or interest in learning about or taking on alternative technologies and approaches. The District Government can support the building and construction industry by providing job training in new technologies and approaches to building design and operations. These efforts can connect to the District's existing economic initiatives in providing local District residents with important, well-paying jobs that are integral to the community.

Details: To increase workforce capacity, the District Government should partner with a college, technical school or union to hold a technical series on select technologies and approaches, including heat pumps, high-performance detailing, and air sealing performance testing. The University of the District of Columbia offers a potential partner for such a series, while the District Government can act as a facilitator. Hosts should seek participation from the local private inspection community, as well as the District Government's own code and inspection staff.

To expand the development of construction professionals, the District Government should also identify a technical education partner to undertake specific job training. An existing example of such a program is offered by the Central Community College of Nebraska (Central CC). The Mechatronics high-performance building program offers training on ground source heat pumps, solar electric and solar thermal systems, wind turbines, and efficient switching systems. Other areas of the College also offer classes on high-performance thermal envelopes. As part of this, the District and partner(s) should consider developing a contractor-focused education series and pathway toward a "Green Contractor" certification. This industry training is important to ensuring the District has access to enough trained professionals to meet the needs of the programs recommended here.

Building Operator training is also important. Poor energy management can negate all the gains of high efficiency building systems. Modern, energy-efficient commercial buildings require specialized knowledge to operate. Moreover, if the District establishes a Building Energy Performance Standard (BEPS) that includes training and certification of building operators as an alternative compliance path (see Action EB.6), and then local or regional availability of such training needs to be available. A good example is the City University of New York Building Performance Lab, which offers Building Operator Certification (BOC).

The District Government and the University of the District of Columbia have begun exploring establishing a building science center that would provide training to building operators and facilities staff. The University of District Columbia (UDC) Community College also can provide two year degrees and certifications to District residents on building science and energy related topics. Other universities also have interest in this area.

Next Steps

- 1 In 2018, identify and establish relationships with appropriate education and channel partners and launch education programming.
- 2 Collaborate with a major university or other partners in the District to open a center for building science that offers training and certification for building operators.
- 3 Aim to have the job training program operational by 2019.



CCB.8 Integrate energy performance information into residential transactions

Action: Support ongoing green appraisal and green multiple listing service (MRIS) initiatives focused on residential buildings, and endorse a home energy score for single-family and small multifamily homes.

Relevance: Owners and renters are faced with a myriad of choices when choosing a home. In addition to monthly rent costs, or monthly ownership expenses (mortgage, property taxes, and insurance), utility bills are key factors determining housing affordability. However, utility efficiency and energy burden are often left out of the decision tree due to a lack of available data, or technical complexity. Professionals involved in home purchases (e.g., real estate agents, residential lenders and underwriters) often have limited understanding themselves of energy and other sustainability issues. This will enable buyers, renters, and professionals to make more informed decisions. Efforts are already underway in the District to educate homebuyers and train relevant professionals in high-performance building benefits and practices. The District Government should continue to support these efforts, while addressing gaps—including a simplified metric for increasing transparency of energy use. A standardized home energy score will allow owners and renters to make more informed decisions about how their home, or prospective home, uses energy and compares with similar units.

Details: To improve the capacity of homebuyers and professionals, the District Government should:

- Continue supporting efforts to integrate sustainable features into the home sales and valuation process.
- Work with other cities, utilities, and the real estate community to develop a new standard for the Multiple Listing Service.
- Continue green training for appraisers and collaborating with the Appraisal Institute.
- Continue encouraging residential lenders and underwriters to seek out training so that they can appropriately value sustainable features.
- Support education and collaboration efforts with real estate associations to educate REALTORS on green valuation fields.
- Support MRIS and DCRA efforts to encourage agents to use green fields in MLS listings.
- Streamline the process of how consumers acquire data to appropriately value sustainable features of homes.
- Support a follow-up to the Institute for Market Transformation's green home valuation study.¹⁸⁰
- Adopt a transparent home energy scale for residential units. There are several examples of a home energy score, including the U.S. Department of Home Energy Score that is being adopted by cities across the country.¹⁸¹ This data must be included in MLS listings, and systems like Northeast Energy Efficiency Partnership's Home Energy Labeling Information Exchange may be able to help.¹⁸² For such a program to be successful, the following aspects are required:
 - Full cooperation from local utilities to access utility data and use it to develop scores.
 - Safeguards to ensure data confidentiality.
 - Easy availability to targeted customers (e.g., homeowners, renters).
 - Integration with regional multiple listing service website MRIS (for residential users).

¹⁸⁰ Recommendations from DOE's Single Family and Small Multifamily Working Group.

¹⁸¹ <https://betterbuildingssolutioncenter.energy.gov/home-energy-score>

¹⁸² <http://www.neep.org/initiatives/energy-efficient-buildings/green-real-estate-resources/helix>

Next Steps

- 1 Partner with U.S. DOE's Better Buildings Home Energy Information Accelerator, and work with other jurisdictions and companies to expand access to home-energy information and develop a pipeline of homes using these tools.¹⁸³
- 2 Assign staff in DOEE and DCRA to act on the recommendations listed above.
- 3 Review these efforts once a year to gauge effectiveness and adjust actions.

4.3.1.4 LEADERSHIP AND CATALYZING CHANGE

CCB.9 Create or Leverage Existing Mid-Atlantic government leadership groups to accelerate market transition

Action: Work with partners in other leading jurisdictions to either create a new Mid-Atlantic Deep Energy Leadership Group, or leverage and expand an existing group to help accelerate the market transition toward high-performance buildings.

Relevance: While the District market is substantial, it has limited capacity to facilitate broader market transformation. Nonetheless, it can multiply its impact by partnering with leading jurisdictions to drive adoption of high-performance buildings. The District already collaborates through the Metropolitan Washington Council of Governments (MWCOC) on energy and climate related work. It can expand this coordination in both depth with the MWCOC and breadth with larger cities within the mid-Atlantic region. This would especially help foster a larger market for high performance building component such as triple-pane windows. In bringing the region's cities, counties, and states into a shared agenda, the District could accelerate its own transition and likely reduce costs.

Details: The District should identify partner jurisdictions and begin building a regional action coalition, using the elements of the Plan as a platform. The District already plays a leading role in the Climate, Energy, and Environment Policy Committee of the MWCOC, which is can leverage to facilitate the adoption of building-related actions by other cities on DC Council.

The District should also expand collaborations with other mid-Atlantic cities such as Baltimore, Richmond, and Philadelphia. There is already a mid-Atlantic Sustainability Network, organized by the EPA Region 3 office in Philadelphia, made up the sustainability officials from the largest cities in each metropolitan region, along with a representative from an intergovernmental group such as MWCOC. This group has traditionally focused on issues such as urban heat islands and transportation, but could be expanded to address building energy use. The Carbon Neutral Cities Alliance or a similar organization could also facilitate similar connections, and move forward other elements of the Plan. For example, it may be easier to pursue a more aggressive code update if it is pursued jointly by jurisdictions in the same climate zone. Regional building-energy conferences would enjoy higher levels of participation than those held at the District scale. Similarly, building tours and other educational programs could attract a broader audience if regionally advertised.

¹⁸³ <https://betterbuildingsinitiative.energy.gov/accelerators/home-energy-information>

The Regional Code Collaboration (RCC) in Washington State, led by King County, offers a small but compelling example of such a partnership. Over the last several years, the RCC has worked collaboratively to develop an array of draft deep green codes, which RCC members are able to adopt or modify to suit their particular needs. The RCC has also successfully championed the statewide adoption of a significantly higher energy efficiency requirement for multifamily buildings. However, while the District can benefit from such a regional coalition, it should not let it limit its own progress. Inter-jurisdictional consensus is always challenging, and the District should maintain its momentum and include other leaders as they are able and willing to join in.

Next Steps

- 1 In 2018, open conversations with existing groups such as the Mid-Atlantic Sustainability Network, to test for alignment. If necessary, establish a new coalition.
- 2 During 2018, establish or expand the coalition and begin forming a common agenda.

CCB.10 Build examples of breakthrough design in government and/or publicly-financed buildings

Action: The District Government should require all significant new projects that it builds or finances to meet 2032 EUI targets. Place net-zero energy requirements on the redevelopment of surplus properties bid out to the private sector.

Relevance: High-profile real-world examples of “what is possible” help rapidly advance sector-wide change. Buildings such as Seattle’s Bullitt Center have completely recalibrated the national conversation about what is feasible in a way that concept drawings and building models never will. Issaquah, Washington’s zHome, the first multifamily net-zero energy building in the United States, has also had impressive catalytic effects. Within two years of the completion of zHome, two other highly energy efficient projects were built only a few miles away.¹⁸⁴ Neither building was required to achieve a high level of performance but was instead responding to local expectations and possibilities.

The District Government has recently begun to include net-zero energy criteria for projects it either builds or finances. It should expand and institutionalize this program.

The District Government can raise the design-standards bar when developing larger campus-style developments with multiple buildings on consolidated sites. In some cases, the property may stay in District hands (for example, the Washington Mystics arena at St. Elizabeth’s). In other cases, such as the former Walter Reed Army Medical Center, private developers may assume control, but under the guidance of District agencies (such as the Office of the Deputy Mayor for Planning and Economic Development (DMPED)) or approval documents (a Small Area Plan that includes sustainability requirements). For all such sites, the District Government should consider neighborhood-scale energy systems oriented toward achieving the maximum GHG reductions possible.

¹⁸⁴ The two buildings are Fire Station 72, the most efficient fire station in the world, and the Swedish Regional Medical Centre, one of the most efficient regional hospitals in the United States with an observed EUI of 108.

Details: Over the next five years, the District Government should build on the existing net-zero energy criteria in its Request for Proposals (RFPs) process by requiring new construction funded by the District to achieve net-zero energy performance. Through this expansion, the District will:

- Lead by example.
- Create built examples and real-life education platforms.
- Gain substantial internal capacity in the design and construction of high-performance buildings, building respect and credibility with the private sector.
- Develop cost-effectiveness analytics based on actual performance.
- Build knowledge in the local design, contracting, and subcontracting communities about high-performance buildings.

Net-zero energy buildings and neighborhood-scale energy systems offer improved resilience to power outages; they tend to maintain a more comfortable internal temperature through blackouts.¹⁸⁵ As such, the District may wish to include thorough resilience performance criteria in addition to net-zero energy requirements.

The District should also include net-zero requirements for the properties it brokers for sale. As the kinds of financial information and bid processes necessary for District Government-funded project can differ from those associated with private development, these types of projects will offer private builders more relatable examples of net-zero buildings. The District Government must ensure the bid design process clearly establishes design-performance expectations. It should base these on a building's projected EUI without plug loads to ensure that its heating and cooling systems operate at the highest possible level of performance. The District may also choose to specify certain components (such as ground source and/or CO2 based heat pumps) to promote the use of regionally suitable technologies.

The overall costs of these higher-performing buildings should be similar to those the District Government itself would have built, affording the District Government the opportunity to share financial success stories to help move the broader market. A study conducted within the District indicated that the cost premium for highly energy efficient buildings is approximately 1% to 12%, and that achieving net-zero energy performance increases the estimated cost premium to 5% to 19%, depending on building type.¹⁸⁶ However, it also indicated that the total cost of ownership of these buildings (including energy costs) is likely to be lower, depending on interest rates.¹⁸⁷

Project developers—and affordable housing developers in particular—need access to financing tools that help defray incremental first cost increases. For example, bonds may be suitable, in that they offer long-term payback structure and carry low interest; the increase in bonded amount and monthly payment is typically less than the saved energy costs.¹⁸⁸ Upon project completion, the District Government should document and report financial data to help tell the story of its transition to net-zero.

Finally, the District Government should maximize the visibility—and thus the educational benefit—of existing high-performance facilities. DGS's BuildSmartDC.com website is the current forum to find information on the District's existing cohort of high-performance buildings.

¹⁸⁵ Wilson, A., 2015, Icebox or Oven - What Happens to Interior Temperatures When the Power Goes Out.

¹⁸⁶ Net-zero and Living Building Challenge Financial Study: A Cost Comparison Report for Buildings in the District of Columbia, 2013, http://doee.dc.gov/sites/default/files/dc/sites/ddoe/service_content/attachments/20140411_Net%20Zero%20and%20Living%20Building%20Challenge%20Study_FINAL.pdf

¹⁸⁷ Matthiessen, 2012, The Power of Zero report; MacLay, 2014, The New Net Zero.

¹⁸⁸ Matthiessen, 2012.

However, it should provide more information on each building. The District would also benefit from cross-referencing the website with other District Government sites.

The existing cohort of high-performance buildings can also be highlighted with tours, case studies, or similar marketing efforts. The District Government should open its high performance buildings in conjunction with community green-living festivals, and include them in any tours conducted for industry professionals. It should facilitate public access to key design elements, and visits to mechanicals rooms, and so on. The District Government may also want to consider turning these buildings into sustainability hubs by locating key energy and environmental programs into their spaces, including DOEE and/or the DCSEU.

Next Steps

- 1 In 2018, identify opportunities to open the District's high performing buildings for public and industry tours.
- 2 In early 2019, adopt a policy requiring all future facilities built or partially funded by the District to achieve 2032 EUI targets and include appropriate resilience measures.

CCB.11 Recognize leadership with a catalog of best performing buildings and a cohort of local building energy leaders

Action: Establish energy leadership groups made up of prominent and forward-thinking design and construction industry members. Use available energy performance benchmarking data to identify and highlight the District's best-in-class energy performers.

Relevance: Leadership is an important aspect of any change or transformation. Identifying, profiling, highlighting, and learning from leading buildings and industry professionals can help accelerate adoption. Targeting both individuals and projects offers other industry professionals an opportunity to learn why different choices were made, how novel approaches and designs were achieved, and where and to whom else local building professionals can turn to for additional support.

Details: Pulling local leaders together, recognizing their contributions, and uniting them around a common understanding and strategy could greatly accelerate forward movement on energy efficiency and renewable energy. The District Government should establish leadership cohorts in conjunction with local partner organizations in existing buildings, new construction, and distributed energy resource integration (e.g., solar panels, battery storage). These leadership cohorts should coordinate closely and share membership with (or be subcommittees of) the District's Green Building Advisory Council and the Green Building Technical Advisory Group to the District's Construction Codes Coordinating Board (CCCB).¹⁸⁹

The District's energy benchmarking and disclosure program will prove a key resource in creating a catalog of local high-performing buildings. DOEE can start by identifying a set of top performing buildings in each building use type (office, multifamily, institutional, etc.). It might then secure additional performance data from building owners and operators as part

¹⁸⁹ <http://dcra.DC.gov/service/construction-codes-coordinating-board>

of creating short but informative case studies on each building. These case studies could include submetering data and technical information on design, equipment, and technologies, operations and maintenance policies and practices, and any unique issues that may affect energy performance in either direction. The District Government should then profile these high performers through the various channels and forums recommended in this section.

Finally, the District Government should consider expanding its existing Sustainability Awards to recognize persons or organizations that have taken extraordinary or innovative steps to reduce fossil fuel use from buildings. Awards can take little time and require few financial resources to establish, but make a strong statement to stakeholders and the public. By explicitly focusing on fossil fuels, the District Government will send a strong signal that it is committed to meaningful climate action and energy transformation.

Next Steps

- 1 In 2018, perform an initial assessment of best-in-class buildings using energy performance information from the benchmarking dataset, and begin obtaining case study information.
- 2 In 2018, require building owners to publish Target Finder scores as soon as they have been determined during the development process.
- 3 In 2018, require building energy models to use standardized and realistic assumptions for key factors such as occupancy, set points, and plug loads. Specify these assumptions by referencing one or more national and publicly available sources, such as the COMNET Modeling Guidelines and Procedures.¹⁹⁰
- 4 In 2018, establish partnerships with one or two leading organizations dedicated to advancing deep energy efficiency in new construction.
- 5 Use the existing Green Building Advisory Council (GBAC) to act as a sounding board and advocate for deep energy efficiency acceleration in the District
- 6 Develop and present an award in conjunction with first regional energy conference starting in 2018.

¹⁹⁰ <http://comnet.org/download-pdfs-mgp-manual>

CCB.12 Implement a high-performance energy media, outreach, and communications strategy

Action: The District Government should create a “narrative of success” in addressing climate change and fossil fuel independence in the building sector as a core element of its media and outreach strategy.

Relevance: The District can create a “virtuous cycle” of achievement by drawing a line in messaging between energy efficiency and renewable energy and successful net-zero energy buildings. Demand for high-performance buildings can increase as the principles and benefits become well-known and better understood. Individual homeowners and office tenants will seek higher levels of efficiency in their homes and workplaces.

Details: The District is positioned near major media channels such as National Public Radio, *The Washington Post*, and bureau offices of nearly every major media network. Many of these outlets regularly cover climate issues and solutions. The District Government also has excellent communications capacity via social and digital channels and platforms.

The District Government should create a narrative that combines positive success stories of net-zero energy homes and offices with information about available energy incentives and opportunities. Topics might include:

- What life is like in a net-zero energy home,
- How much it costs to achieve net-zero energy performance and what incentives are available,
- How to invest in renewables, and
- How a building can be retrofitted to achieve net-zero energy performance over time.

These stories should include practical information about the basic actions residents and businesses can take to incrementally improve energy performance, such as LED lighting, insulation, home sealing (for airtightness), and PV installation, with links to incentives where available.

Across the board, the District should focus on simple messages, clear graphics, and photographs that tie small actions to tangible financial and GHG reduction benefits. Stories highlighting technology, innovation, and thoughtful “lifestyles of integrity” can resonate with the public. In addition, the District Government should partner with trusted community organizations such as social justice advocacy groups to ensure the messages reach and resonate with all groups and neighborhoods.

Next Steps

- 1 Create a short-term media strategy for specific stories related to energy innovation and efficiency. Establish strong coordination between DOEE and District Government communications to ensure stories are told as part of a larger narrative of change. Consider a small budget to promote these stories via the District's social media channels.
- 2 Partner with trusted community organizations such as social justice advocacy groups to ensure communications reach and resonate with all communities.

CCB.13 Create a coordinated green jobs and workforce development platform

Action: Building on DOEE's existing Green Pathways website,¹⁹¹ create a robust clearinghouse for training and workforce development opportunities and funding.

Relevance: At the national level, the growth of the green economy is expected to continue to outpace that of the whole economy, and green jobs are expected to grow faster and pay more compared with other jobs.¹⁹² Given the District's steadfast commitment to climate, energy, and green infrastructure, an opportunity exists for additional green job training programs.

Details: While, as the Plan suggests, green training and workforce development could be improved and expanded, there are several existing programs. A centralized online platform, in coordination with the District's Workforce Investment Council, could help increase their impact.¹⁹³

The online green jobs and workforce development platform would be a one-stop-shop for those interested in career pathways and training opportunities for energy-related jobs. Several different organizations, government agencies and other stakeholders are currently engaged in green workforce development programs. These include DOEE-funded organizations, District of Columbia Public Schools (DCPS) Career and Technical Education programs, union and association training and apprenticeships, UDC and UDC Community College degrees and certification programs, the DCSEU, summer youth programs managed by DOEE (e.g., Green Zone Environmental Program), among others.

The platform would ideally improve coordination between these programs, the students enrolled, and the organizations that administer and fund them. The District could then build on this coordination to identify and address gaps and opportunities related to green jobs training. The platform could provide, for example, career and salary information about green jobs, training, education, and employment opportunities, and resources for residents and employees. It could also link companies with job seekers.

To supplement this educational platform, the District should partner with local, trusted community organizations to conduct direct outreach to LMI communities. Include requests to partner organizations to leverage networks, expertise, and existing projects to the benefit of the

¹⁹¹ <http://doee.dc.gov/greenpathways>

¹⁹² Analyzing Building Energy Efficiency Job Opportunities, July 2015, Jobs for the Future, https://c.ymcdn.com/sites/www.nibs.org/resource/resmgr/CWCC/BuildingEnergyJobOpps_2015.pdf.

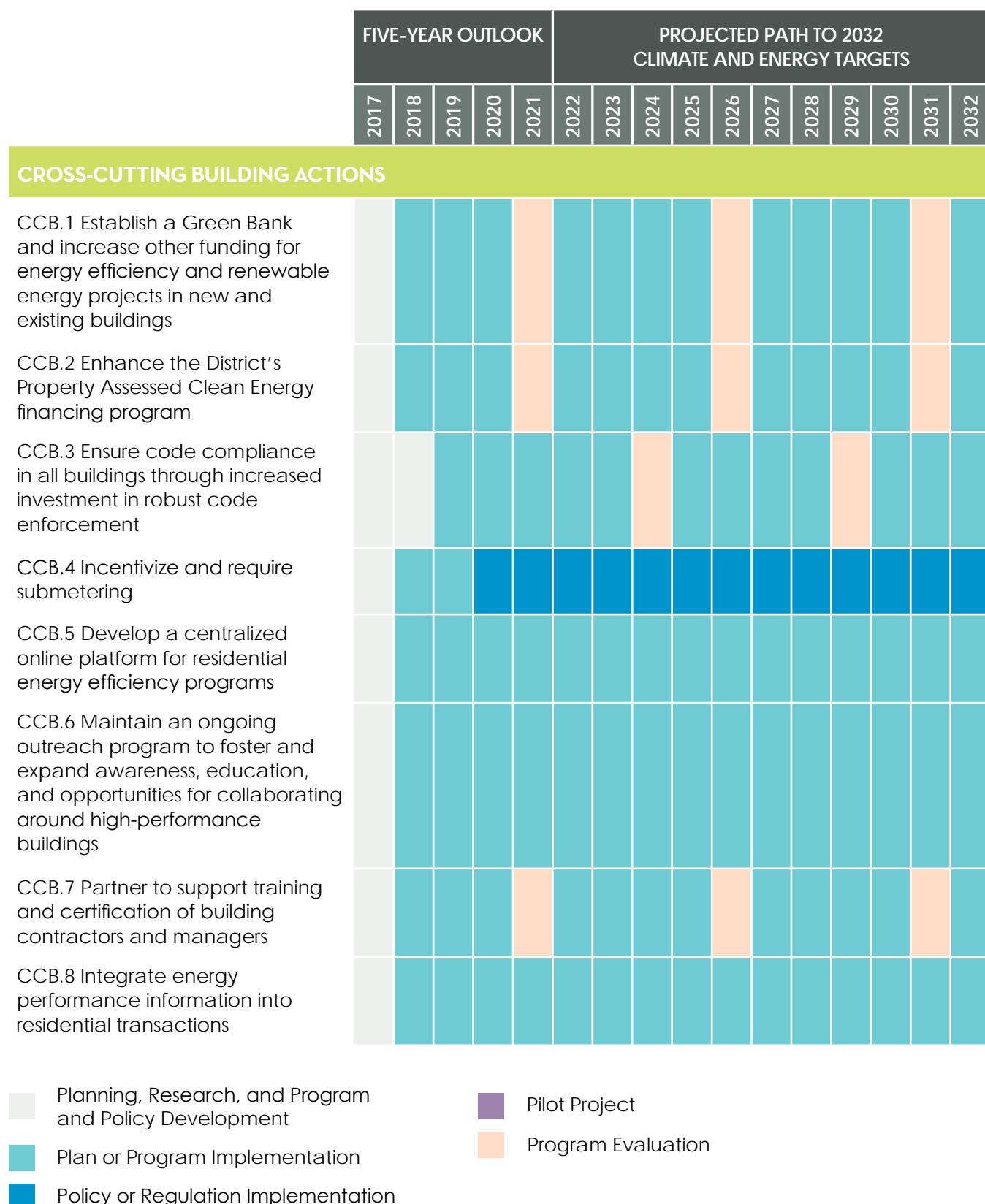
¹⁹³ This action should be aligned with Actions CCB.5 and CRE.4.

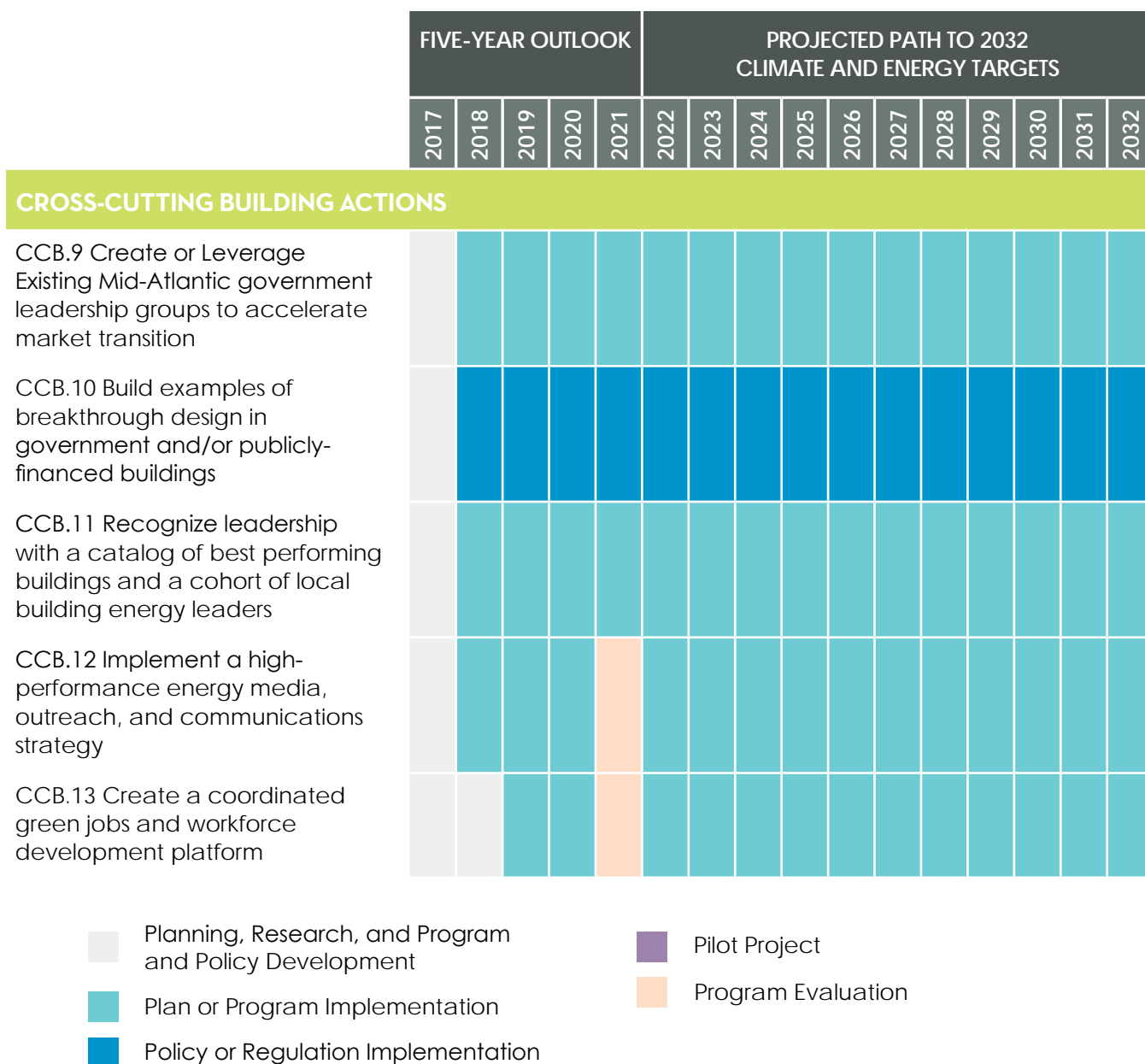
jobs platform. It could also promote green jobs to LMI communities. The District Government should explore extending training and education efforts to build pathways to meaningful employment for at-risk youth, LMI communities, formerly incarcerated people, and underserved communities.

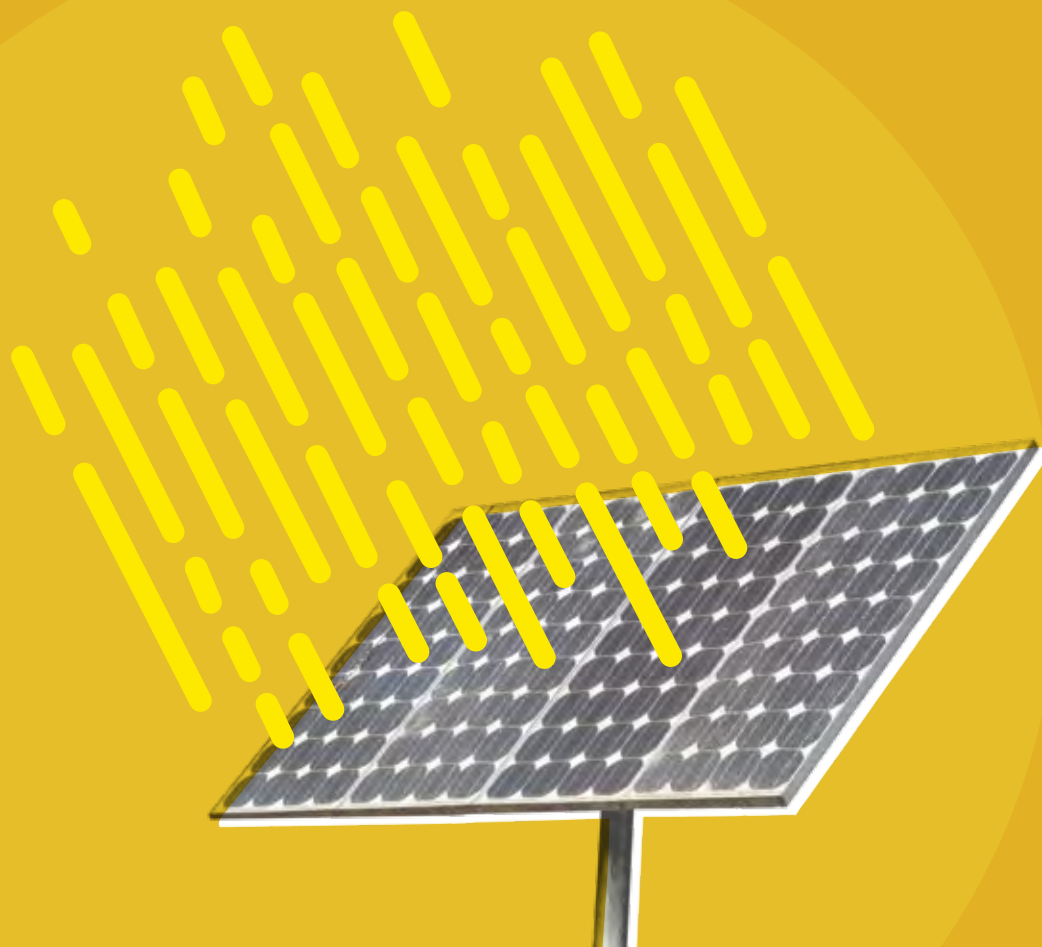
Next Steps

- 1 In 2018, create a new position or expand an existing position at DOEE to coordinate green jobs and green economy initiatives.
- 2 In 2019, create an online platform to provide a more seamless and comprehensive listing of green job training opportunities throughout the District, or commission an organization to do this through a competitive request for proposal.
- 3 Support the online platform with an additional outreach and communications strategy in partnership with a trusted community organization to facilitate offline engagement with LMI communities.

4.3.2 CROSS CUTTING BUILDING ACTIONS ROADMAP







ENERGY SUPPLY SYSTEM

5 ENERGY SUPPLY SYSTEM

In this chapter, recommendations are provided for two areas related to the District's energy supply system: Actions to increase the supply of zero greenhouse gas (GHG) emission energy (Section 5.1) and actions to modernize the energy delivery system to support sustainability, resiliency, interactivity, and affordability (Section 5.2). The Plan summarizes both sets of recommendations in roadmaps at the end of the chapter, which the District Government can use to guide implementation over the five-year span of the *Clean Energy DC Plan* (Plan), as well as future actions to 2032.

5.1 CLEAN AND RENEWABLE ENERGY SUPPLY

5.1.1 EXISTING POLICIES AND ACTIONS

To meet its GHG reduction targets, the District must significantly increase the share of renewable energy in its energy supply. To this end, it has set a target that clean and renewable sources will supply half of the energy used within its boundaries by 2032.¹⁹⁴ In pursuit of these targets, the District Government has implemented a broad set of tools and programs to increase renewable energy supply, both within and outside the District; foster demand for PV and other renewable energy systems, and; adjust planning and policy to advance these objectives.

5.1.1.1 ENERGY GENERATED OUTSIDE THE DISTRICT

The District receives almost all its energy from sources beyond its borders. While utilities generate most this energy from natural gas, coal, and nuclear fission, a growing portion of this power comes from renewable sources, including increasingly price competitive utility-scale solar and wind. The District's Renewable Portfolio Standard (RPS) is its primary renewable energy policy for utility-supplied energy. The RPS is a mandate intended to increase the total proportion of renewable energy sold by electricity suppliers to customers. The current RPS directs utilities to source 20% of District electricity from renewable sources by 2020 (including 2.5% from local solar systems by 2023) and 50% by 2032 (including 5% from local solar systems).^{195,196} Pepco (in its role as a Standard Offer Service provider¹⁹⁷) and competitive electricity suppliers may comply with the RPS through the following two approaches:

¹⁹⁴ Sustainable DC Plan, 2012, p.11

¹⁹⁵ Renewable Portfolio Standard Expansion Amendment Act of 2016, DC Act Number A21-0466, signed July 25, 2016, effective October 8, 2016.

¹⁹⁶ 2015 Quarterly State of the Market Report for PJM: January through March, p.248, http://www.monitoringanalytics.com/reports/PJM_State_of_the_Market/2015/2015q1-som-pjm-sec8.pdf

¹⁹⁷ Recall that the Standard Offer Service (SOS) is the electricity purchased for those District ratepayers who do not choose a competitive supplier for their electricity. This purchase is currently made by Pepco under oversight of the PSC, but the issue of reforming the SOS is currently being investigated by the PSC in Formal Case 1017.

1. Procuring renewable energy certificates (RECs) or solar renewable energy certificates (SRECs) for the local solar energy requirement, which may be accomplished by one of the following:
 - a. Purchasing unbundled RECs or SRECs.
 - b. Purchasing energy bundled with associated Generating RECs or SRECs (and retiring the associated RECs or SRECs).
2. Making alternative compliance payments (ACPs) to the District for that portion of the electricity supply that does not meet the RPS requirement.

RECs are tradable certificates that represent ownership of the environmental attribute, or the “greenness,” of the generated electricity. The owners of renewable energy generators can choose to retain ownership of the credits attributed to their facilities, or sell it to another party – in this case, electricity suppliers. Once sold, RECs are “retired,” meaning that they cannot be used by another party to meet its renewable-energy generation targets. This avoids a potential situation in which RECs are double-counted, or where both the energy generator and any REC purchasers account for the quantity of renewable energy generated. The District’s RPS requires that RECs come from electricity produced by renewable sources within the PJM Interconnection Region (PJM) or within an adjacent state.¹⁹⁸

These compliance options influence the GHG reductions that the District can achieve and account for. For example, the 2014 RPS required renewable energy to supply 10.5% of total electricity in the District, whereas Pepco’s fuel mix for its Standard Offer Service included only approximately 4.0% from renewables. Pepco thus had to purchase RECs and make alternative compliance payments to comply with the RPS requirements.¹⁹⁹ Other suppliers would have to do the same. As discussed in Chapter 2, only RECs that affect the GHG emissions factor used by the District in their GHG inventory (from the EPA’s RFC-East eGRID sub-region) can be counted toward GHG emissions reductions according to the GHG accounting protocol used by the District.²⁰⁰ Therefore, the way in which electricity suppliers comply with the RPS significantly impacts renewable energy usage and GHG reductions.

In contrast, Solar Renewable Energy Certificates, or SRECs, that are used to comply with the District’s solar RPS requirement, can only be generated from solar-electricity projects located in the District or in locations served by a distribution feeder that serves the District. Since SRECs must be generated from solar energy sources within the District’s power supply, the local solar carve-out under the RPS does contribute to GHG reductions in the District.

There are currently three different Alternative Compliance Payment rates:

- Five cents for each kilowatt-hour of shortfall from required Tier 1 renewable sources;
- One cent for each kilowatt-hour of shortfall from required Tier 2 renewable sources; and
- Fifty cents in 2016 through 2023, 40 cents in 2024 through 2028, 30 cents in 2029 through 2032, and five cents in 2033 and thereafter for each kilowatt-hour of shortfall from required local solar energy sources.

¹⁹⁸ The RPS further rules clarify that states within the PJM Interconnection Region currently include Delaware, the District of Columbia, Illinois, Indiana, Kentucky, Maryland, Michigan, New Jersey, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia and West Virginia. Public Service Commission of the District of Columbia, 2015 Report on Renewable Energy Portfolio Standard, January 30, 2015.

¹⁹⁹ Public Service Commission of the District of Columbia. Report on the RPS for Compliance Year 2015. https://dcpsc.org/getmedia/901b3c18-4859-435d-ae1a-ca296584c26b/ahamr5_542016_831_1_FC_-_2016_-_E_-_REPORT.aspx

²⁰⁰ Recall from Chapter 2 that the District uses ICLEI’s U.S. Community Protocol for Accounting and Reporting Greenhouse Gas Emissions.

Tier 1 renewable sources include solar, wind, biomass, landfill gas, wastewater treatment gas, geothermal, marine energy, fuel cells fueled by any of the above resources, and wastewater used as a heat source as a sink for heating or cooling systems. Tier 2 renewable sources refer to hydropower other than pumped storage.²⁰¹

Under DC Code § 34-1436, all Alternative Compliance Payments supply the District's Renewable Energy Development Fund (REDF). DOEE administers the REDF, which helps fund new solar energy sources in the District. Due to the shortage of SRECs to meet the local solar carve out, SRECs from these new solar energy sources will remain in the District and thus will contribute to GHG reductions. Since REDF funding can be used for a number of activities that support new solar energy—such as electrical upgrades, structural improvements, and new electrical or thermal storage systems—the quantity of solar capacity added per dollar of ACP funding varies.

While it is not affected by the RPS, the District's primary natural gas provider has also reduced emissions. In March 2016, Washington Gas became a founding partner in the EPA's Natural Gas STAR Methane Challenge. This voluntary industry program works to reduce methane emissions and improve air quality. The commitment includes a goal to reduce the GHG emissions per unit of natural gas delivered 18% by 2020 relative to 2008—a target the company is on track to achieve.²⁰²

5.1.1.2 ENERGY GENERATED WITHIN THE DISTRICT

Energy generated within the District refers to that supplied to District customers via on-site generators, such as solar photovoltaic (PV) arrays or combined heat and power (CHP) plants. A 2013 DOEE study found that the District's technical capacity for solar PV generation lies somewhere between 1,207 and 2,000 MW. A more recent analysis by Mapdwell, an urban solar-mapping company, indicates a solar PV technical potential of approximately 1,300 MW.²⁰³ This potential may be reduced in the light of site-specific and regulatory limitations, such as suitable roof space, historical preservation, zoning, and other building design priorities. Still, solar PV very likely represents the vast majority of renewable electricity generation capacity possible in District.²⁰⁴ However, as of December 1, 2017, the Public Service Commission (PSC) had only certified 44.9 MW of solar PV and thermal systems in the District, with an additional 22.4 MW eligible for the RPS' solar requirement and certified by the PSC located beyond its boundaries.²⁰⁵ The difference between potential versus installed capacity starkly highlights a significant untapped opportunity.

As noted above, the District Government's expanded RPS now requires that local solar systems supply 5% of electricity by 2032.²⁰⁶ To achieve this target, the District Government has committed to funding renewable energy and energy efficiency projects through several mechanisms.

The *Renewable Portfolio Standard Expansion Amendment Act of 2016* (The Act), effective October 8, 2016, established the District's Solar for All Program (Solar for All). The legislation seeks to expand the District's solar capacity, to increase the amount of solar generated within

201 <http://programs.dsireusa.org/system/program/detail/303>

202 Washington Gas Joins the EPA's Natural Gas STAR Methane Challenge Program as Founding Partner, March 30, 2016, <http://www.businesswire.com/news/home/20160330005985/en/Washington-Gas-Joins-EPA%E2%80%99s-Natural-Gas-STAR>

203 Email between DOEE and Mapdwell staff (April 8, 2016).

204 The report's generation potential and cost figures will change as technologies improve, particularly for rooftop solar. GDS Associates for the District Department of the Environment, *Renewable Energy Technologies Potential for the District of Columbia*, 2013, p.3

205 Public Service Commission of the District of Columbia, *Monthly Update of Solar Generator Certification*, retrieved July 27, 2016 from http://dcpsc.datanetusa.com/Electric/Solar_generator_certification.asp.

206 Renewable Portfolio Standard Expansion Amendment Act of 2016.

its boundaries, and provide the benefits of locally-generated solar energy to low-income households, small businesses, nonprofits, and seniors.

Funded by the Renewable Energy Development Fund and administered by DOEE, Solar for All's specific targets are to provide the benefits of solar electricity to 100,000 low-income households (at or below 80% Area Median Income), and to reduce their energy bills by 50% (based on the 2016 residential rate class average) by 2032. As described in the Solar for All Implementation Plan, DOEE will implement Solar for All in five three-year phases, to allow the program to respond to market changes and overcome barriers.²⁰⁷ The initial implementation phase (FY17-FY19) will include development of 30 to 60 MW of solar capacity, subject to funding availability.

DOEE's ongoing Solar for All Innovation and Expansion Grants under the initial implementation phase are helping to identify solutions to the core barriers hindering solar deployment in the District. Other District initiatives include the RPS's Sustainable Energy Trust Fund (SETF), and programs such as the District of Columbia Sustainable Energy Utility (DCSEU). Actions that have recently been proposed or are in progress include:

- Legislation to reduce fossil fuel consumption and increase opportunities for community solar and renewable energy systems.
- A feasibility study to identify opportunities for neighborhood-scale energy systems, including microgrids with emphasis on distributed energy resources.
- The creation of opportunities to arrange power purchase agreements and install renewable energy systems on government and institutional buildings.²⁰⁸
- The District also provides a range of financial incentives to encourage solar adoption, including:
 - Exemptions of residential solar systems from property taxes.
 - Net metering and virtual net metering (via the District's Community Renewables Energy Act of 2013).
- The opportunity to sell SRECs to electricity suppliers regulated by the District's Renewable Portfolio Standard.²⁰⁹
- Support in procuring community solar purchases.
- A commercial property assessed clean energy (PACE) program to minimize or eliminate upfront system costs.

Combining these programs, a \$20,000 5 kW system could be eligible for as much as \$9,507 in upfront incentives, while generating 6,089 kWh yearly and saving the system owner \$792 a year.²¹⁰ In addition, the District is actively exploring a requirement that all new buildings must be either net-zero, where all energy required to operate the building is produced on-site, or net-positive. The latter state describes a building that produces more clean energy than it consumes.²¹¹

In support of these actions and to smoothly integrate higher levels of local generation, the District's PSC has initiated investigations into the modernization of its electricity infrastructure. As

207 https://doee.dc.gov/sites/default/files/dc/sites/ddoe/service_content/attachments/DOEE-%20Report-%20Solar%20for%20All%20Implementation-%20Final%20for%20Transmittal.pdf

208 Actions 2.1-2.5 of Energy Goal 2, Sustainable DC, 2012; Sustainable DC Second Year Progress Report, 2015, pp.5,10

209 Solar renewable energy certificates (SRECs) are used to meet the solar requirement of the District's Renewable Portfolio Standard and have a higher value than other renewable energy certificates (RECs).

210 Mapdwell DC, <https://www.mapdwell.com/en/solar/dc>

211 Sustainable DC, 2012, p.54

a part of this endeavor, the District Government will work with local educational and workforce development institutions to train residents for new jobs in the renewable energy and energy efficiency industry.²¹²

Modernizing the District's electricity infrastructure also means developing ways to manage an increasing number of on-site intermittent renewable generation and energy storage, and sophisticated tools for building efficiency and demand response. In this regard, microgrids or other distributed energy resources (DER) management systems offer the tools to integrate and optimize these resources. The availability of flexible options, as a DER manager, will greatly enhance the District's ability to successfully develop many DER and maximize their benefits to the consumers and the grid. The Plan discusses energy system modernization and integrating DER further in section 5.2.

Finally, various community-based solar power advocacy groups call the District home, including Solar United Neighbors of DC, Groundswell, and Grid Alternatives. These groups work to expand solar access by educating citizens about the technology's benefits, coordinating bulk solar purchases, and working to strengthen the District's solar policies and programs.²¹³ Solar United Neighbors and similar groups have played an instrumental role in the installation of solar systems in the District.

5.1.1.3 GOVERNMENT LEADERSHIP

In addition to the policy actions above, the District has demonstrated considerable leadership in renewable energy procurement. The DC Department of General Services (DGS) sources 100% of its own operational electricity from renewable sources. It does so by purchasing renewable-energy certificates, as well as via the trio of 20-year power purchase agreements it signed in 2015 and 2016.²¹⁴ Power purchase agreements (PPA) are contracts between electricity generators (i.e., sellers) and consumers (i.e., buyers) in which a buyer provides the payment stream necessary for a seller to generate the electricity. The contracts ensure that electricity²¹⁵ generation can help finance the development of projects in instances where it might otherwise be unfeasible.

The first PPA, signed by the District in 2015, is one of the largest wind PPAs ever entered into by a U.S. local government. It sources Pennsylvania wind power to provide approximately 30% to 35% of the DGS' electricity load.²¹⁶ The two solar PPAs are for 11.4 MW of local solar PV systems that are being installed on the roofs and parking lots of District Government-owned facilities.²¹⁷ The solar PPAs represent the largest on-site solar project undertaken by a U.S. city, and will supply an additional 3.5% of DGS' electricity load.

Because of this leadership, the District leads the country in the EPA's Green Power Community Challenge. As of April 2016, renewable energy power purchases now comprise 13.2% of all electricity sold in the District.²¹⁸ In recognition of these efforts, the District received a C40 Cities Award for Global Leadership on Climate Change at the COP21 climate change conference in Paris in 2015.²¹⁹

²¹² Actions 3.3 and 3.4 of Energy Goal 3, Sustainable DC, 2012; Sustainable DC Second Year Progress Report, 2015, p.10

²¹³ <http://www.dcsun.org/>

²¹⁴ Sustainable DC Plan, 2012, p.14; Federal Department of Energy, <http://www.energy.gov/savings/green-power-purchasing-1>, accessed February 8, 2016

²¹⁵ More information on PPAs can be found on the World Bank website: <http://ppp.worldbank.org/public-private-partnership/sector/energy/energy-power-agreements/power-purchase-agreements>

²¹⁶ <http://mayor.DC.gov/release/mayor-bowser-announces-groundbreaking-wind-power-purchase-agreement>

²¹⁷ Mayor Bowser Announces Largest Municipal Onsite Solar Project in US., <http://dc.gov/release/mayor-bowser-announces-largest-municipal-onsite-solar-project-us>

²¹⁸ EPA Green Power Partnership, Community Profile, Washington, DC, <https://www.epa.gov/greenpower/green-power-communities>, accessed May 30, 2016

²¹⁹ DC.gov, 2015, <http://DC.gov/release/district-columbia-receives-c40-cities-award-global-leadership-climate-change>

Like other jurisdictions leading the shift to renewable energy, the District has much to build on but will nevertheless require stronger and more coordinated action to achieve its long-term targets. The remainder of this chapter provides a series of short-term actions and long-term policy and regulatory adjustments that the District can quickly implement to advance its renewable energy programs.

In addition to the actions below, the District can support clean and renewable energy development through the development of a DC Green Bank, as outlined in Action CCB.1, as well as with PACE financing, as outlined in Action CCB.2



The image above captures one of the wind turbines producing power for the District of Columbia under a Power Purchase Agreement.

5.1.2 RECOMMENDED ACTIONS

5.1.2.1 RENEWABLE ELECTRICITY SUPPLY FROM OUTSIDE THE DISTRICT

CRE.1 Design and manage the RPS to drive renewable energy generation and GHG reductions

Action: Investigate how best to design and manage the Renewable Portfolio Standard (RPS) to drive increasing investments in new renewable electricity generating capacity and maximize GHG reductions.

Relevance: In 2016, the District Government adopted a 50% RPS for 2032, including a requirement that local solar systems provide 5% of electricity consumed in the District. This will be about 400 MW.²²⁰ The new RPS builds on an earlier requirement that renewable sources deliver 20% of the District's electricity by 2020,²²¹ with at least 2.5% from qualifying local solar PV and thermal systems by 2023.²²²

Buildings that source the majority of their energy from electricity contribute nearly three quarters of the District's GHG emissions.²²³ For this reason, the RPS will play an important role in achieving the 2032 GHG reduction and renewable energy utilization targets.²²⁴ However, the *Sustainable DC Plan's* renewable energy target applies to the entire energy supply, not just electricity. Thus, a 50% RPS, while significant, will not achieve this target in isolation. Furthermore, as discussed previously,²²⁵ the RPS allows electricity suppliers to comply with the RPS without the associated renewable energy affecting the GHG intensity of electricity that supplies the District or, for GHG accounting purposes, without affecting the emissions intensity of the EPA's RFC-East eGRID sub-region. As such, RPS compliance with RECs does not necessarily result in GHG reductions that can be attributed to the District under standard protocols.²²⁶ Suppliers can also comply by making ACPs. Normally, these are financial transactions that would not directly result in GHG reductions.

ACPs are, however, designed to support new local solar-energy generation in the District under the Renewable Energy Development Fund (REDF), including the Solar for All program.²²⁷ Thus, ACPs are increasing solar energy uptake and GHG reductions. Since a number of activities that can support solar—such as electrical upgrades, structural improvements, and electrical or thermal storage systems—do qualify for REDF funding, the amount of solar capacity added per dollar of ACP funding will vary. Therefore, there is no set metric for how much GHG reduction can be attributed to ACPs.

To maximize the effectiveness of the RPS and achieve the 2032 targets, the District Government should drive electricity suppliers to comply in a way that drive GHG reductions, and should adopt a higher future RPS requirement that ultimately decarbonizes the grid. Recognizing legitimate concerns about the cost implications of the RPS, the District should determine how best to design and manage the RPS so that it yields significant GHG reductions while cost-effectively delivering reliable power.

²²⁰ Renewable Portfolio Standard Expansion Act of 2016.

²²¹ 2015 Quarterly State of the Market Report for PJM: January through March, p.248, http://www.monitoringanalytics.com/reports/PJM_State_of_the_Market/2015/2015q1-som-pjm-sec8.pdf

²²² DC Green Building Fund Report: Green Bank, Carbon Pricing, and Deep Retrofit Incentive Study, 2015, prepared by the Coalition for Green Capital, Capital E and the Center for Climate & Energy Solutions

²²³ 2011 District of Columbia Greenhouse Gas Inventory, <http://doee.DC.gov/sites/default/files/dc/sites/ddoe/publication/attachments/GHGInventory-1205-.pdf>

²²⁴ Sustainable DC, 2012

²²⁵ See sections 2.2.1.2 and 2.2.2.1.

²²⁶ Recall the District uses ICLEI's U.S. Community Protocol for Accounting and Reporting Greenhouse Gas Emissions to calculate its community GHG inventory.

²²⁷ <https://doee.dc.gov/service/solar-for-all>

Details: The District's recent strengthening of its new RPS requirement (50% by 2032) aligns with other leading states, including New York and California, which both target 50% by 2030.²²⁸ This change in the RPS can play a significant role in achieving the District's 2032 GHG target. It is also a positive step toward the District's 2050 carbon-neutral commitment. This evolution in the stringency of the RPS from 20% to 50% represents a profound shift in the District's electricity supply. It demands new thinking in how to design the RPS to drive GHG reductions and modernize the energy delivery system to handle increased distributed energy resources (the latter of which is discussed in section 5.2).

At the same time, the PSC and other stakeholders have raised concerns about potential cost impacts on ratepayers. In their *Report on the Renewable Energy Portfolio Standard for Compliance Year 2015*, the PSC found that the total costs of ACPs tripled between 2014 and 2015 (\$6.3 million vs. \$19.9 million), due primarily to a shortage in local solar capacity and thus SRECs to comply with the local solar requirement.²²⁹ Overall RPS compliance costs increased from \$27.4 million in 2014 to \$38.5 million in 2015 and \$47.2 million in 2016.²³⁰ While PJM REC prices have remained relatively stable in recent years, with prices in some PJM states declining 50% in between 2016 and 2017,²³¹ SREC prices are much higher, and the highest among the Mid-Atlantic States.²³²

The PSC continues to support the increased deployment of renewable energy, but has asked the District Government to consider how the RPS can be redesigned to limit ratepayer cost burdens, and has made some specific suggestions.²³³ As a first step, the *Renewable Portfolio Expansion Amendment Act of 2016* required the PSC to submit a report to Council in March 2017 that estimates the amount of solar in the District that could qualify for SRECs but cannot be purchased by suppliers (i.e., retired SRECs). It also recommends how the PSC could adjust annual solar requirements based on its findings.²³⁴ This was part of a careful consideration of the implementation of the new Solar for All program, which aims to reduce by half the electric bills of 100,000 low-income households by 2032 through energy conservation and clean-energy resources. Through this analysis, the PSC found that not enough SRECs were available to meet the RPS solar requirements in 2016, but have not yet recommended ways to adjust RPS requirements.²³⁵

Again, to achieve its GHG reduction target, the District must increase renewable-energy generation and shift toward zero-emission electricity. It must also ensure residents and businesses have access to reliable, affordable electricity. The District Government must, therefore, figure out how to design and manage the RPS in a way that achieves all these objectives. It is a tall order, one requiring new analysis and collaboration with key stakeholders.

Determining How to Design and Manage the RPS: Over the next five years the District Government should convene a collaborative dialog with key stakeholders. Key stakeholders include the PSC, Pepco, the Office of People's Counsel, DOEE, solar developers, and other

228 State Renewable Portfolio Standards and Goals, Jan 15, 2016, National Conference of State Legislatures, <http://www.ncsl.org/research/energy/renewable-portfolio-standards.aspx>

229 Public Service Commission of the District of Columbia, Report on the Renewable Energy Portfolio Standard for Compliance Year 2015, http://www.dcpsc.org/getmedia/901b3c18-4859-435d-ae1a-ca296584c26b/aharris_542016_831_1_FC_-_945_-_2016_-_E_-_REPORT.aspx

230 In 2014, suppliers paid \$21.1 million for RECs and \$6.3 million for ACPs. In 2015, suppliers paid \$18.6 million for RECs and \$19.9 million for ACPs. Comments of the Public Service Commission of the District of Columbia to the Committee on Transportation and the Environment on B21-412, "Solar Energy Amendment Act of 2015" and B21-650, "Renewable Portfolio Standard Expansion Amendment Act of 2016", May 26, 2016, https://cdn2.hubspot.net/hubfs/298813/2016/2016_Blog_Images/PSC_Comments_on_RPS_5-26-16.pdf?t=1474637760598

231 Lawrence Berkeley National Laboratory, 2016 Wind Technologies Market Report, August 2017, https://energy.gov/sites/prod/files/2017/10/f37/2016_Wind_Technologies_Market_Report_101317.pdf

232 Public Service Commission of the District of Columbia, Report on the Renewable Energy Portfolio Standard for Compliance Year 2016, http://www.dcpsc.org/getmedia/1806a06a-51de-4d4d-aa5a-e0cdd0517ecb/ReportREPS2017_050117.aspx

233 p.2, Comments of the Public Service Commission of the District of Columbia to the Committee on Transportation and the Environment on B21-412, "Solar Energy Amendment Act of 2015" and B21-650, "Renewable Portfolio Standard Expansion Amendment Act of 2016".

234 B21-0650 - Renewable Portfolio Standard Expansion Amendment Act of 2016, <http://lims.dccouncil.us/Legislation/B21-0650>

235 Report on the Renewable Energy Portfolio Standard for Compliance Year 2016, Public Service Commission of the District of Columbia, May 1, 2017, http://www.dcpsc.org/getmedia/1806a06a-51de-4d4d-aa5a-e0cdd0517ecb/ReportREPS2017_050117.aspx

consumer advocates. The dialog should determine how to design and manage the RPS to drive GHG reductions while maintaining system reliability and ensuring equity and affordability. The dialog should focus on both the existing 50% requirement for 2032 and a new higher requirement for the future. The District Government should fund research and analysis and provide it in advance to the participants.

The District Government should consider the following when establishing this group's initial agenda:²³⁶

- The projected costs of meeting the current local solar requirement versus procuring renewable energy from outside the District that still drives accountable GHG reductions.
- How to narrow compliance options over time to reduce dependence on ACPs and increase compliance via RECs that reduce GHGs in the District, because they are bundled with the actual purchase of renewable energy or are sourced from within the RFC-East region.
- Potential collaborations with electricity suppliers to finance renewable-energy generators.
- The role of power purchase agreements in increasing compliance that yields new renewable-energy capacity and fewer ACPs.
- How best to coordinate with other PJM states through existing committees to increase the number of cost-effective renewable-energy generation opportunities (with a focus on utility-scale solar and wind) and avoid challenges regarding competition for RECs as states increase RPS requirements.
- A study of the District's realizable solar PV capacity, refining previous technical potential studies, and considering all constraints. This study could also estimate the cost-effectiveness of installing different levels of this realizable potential, and consider ongoing efforts and lessons learned under the District's Solar for All program.
- Alignment with and establishment of related programs to support project financing, reduce compliance costs, provide price stability (for both consumers and suppliers), strategically upgrade the grid, and encourage demand.
- An assessment of new renewable energy between now and 2032 (in conjunction with Action CRE.3). Study the REC-eligible regions for RPS and in the EPA's RFC-East eGRID sub-region (which determines the GHG intensity of electricity in the District). Focus on utility-scale wind and solar.
- The role that existing low- or zero-carbon but not renewable electricity sources (i.e., nuclear) can play in bridging the transition to a renewable energy delivery system.
- Options to encourage private investment, promote business model innovation, and reduce costs (e.g., market mechanisms, government purchasing power, roles for a Green Bank).
- How decreasing compliance through ACPs may affect funding for the District's renewable energy programs, including Solar for All.
- The level and type of investments needed to modernize the energy delivery systems to achieve the District's objectives. The District will likely need to consider the grid both within the existing distribution system, including microgrids, and the larger transmission system shared with neighboring states where electricity is generated.

²³⁶ This list of recommendations is based in part on analyses that other states conducted prior to adopting their own RPS requirements. Some of these items can be informed by previous and ongoing work being done by DOEE and Pepco.

- The potential to mitigate grid and cost impacts through coordinated supply curtailment, energy storage, supply diversity, advanced demand response (i.e., can adjust demand both down and up as necessary), and regional coordination.
- An understanding of how the RPS can be designed to drive only strategic, medium-term investments in fossil fuel-based energy sources like natural gas, to meet peak demand and support grid resilience.
- The potential for energy storage (both within and outside of the District) to increase the proportion of electricity consumed from renewable sources.
- How to balance regulatory stringency with flexible and alternative compliance options.
- Periodic review of RPS to account for costs, grid impacts, and technology and market developments.

These studies should build on the PSC's report to Council on March 1, 2017, and be aligned with existing and future initiatives focused on improving grid resilience, protecting critical infrastructure from power outages, building community microgrids, and integrating local electrical and thermal generating capacity (e.g., FC1050 Investigation of Interconnection Standards, FC1130 Investigation into Modernizing the Energy Delivery Structure for Increased Sustainability).

To properly guide and conduct this work, some direction from District Government leadership regarding the purpose of the RPS with respect to GHG reductions may be necessary. Specifically:

- Recognizing that climate change is a global challenge, does the District Government want the RPS to drive renewable energy generation and GHG reductions irrespective of location?
- Or, does the District Government want the RPS to drive renewable energy generation and GHG reductions in locations that result in GHG reductions that can be attributed to the District under the ICLEI Protocol?

Next Steps

- 1 Convene a working group to lead and facilitate a dialog on how to revise the RPS design and management to hit the District's GHG target while maintaining reliability and affordability.
- 2 Periodically review pre-determined aspects of the RPS every three to five years and work with appropriate PJM committees through the PSC and the Office of People's Counsel.

CRE.2 Provide the Standard Offer Service through aggregated power purchase agreements

Action: Sign aggregated power purchase agreements with renewable electricity suppliers to supply electricity for the Standard Offer Service (SOS) in the District.

Relevance: Alongside the RPS, the District can use power purchase agreements (PPAs) to make significant headway towards its renewable energy and GHG targets. As noted above, the District already signed three PPAs in 2015 and 2016 to supply approximately 33.5% to 38.5% of the District Government's electricity demand with wind and solar energy. The District Government's three PPAs drastically reduced its energy costs, yielding a projected savings of approximately \$75 million over 20 years. It is similarly expected that aggregated PPAs for the SOS could deliver substantial savings for customers.

Details: District ratepayers who do not choose a competitive supplier for their electricity purchase it through the District's SOS, a purchase made by a third party under oversight of the PSC. Pepco has been providing this service, procuring rolling three-year power supply contracts on an annual basis through a PSC-approved short-term competitive bidding process. Although the PSC has directed Pepco to buy power for these ratepayers who do not choose a competitive supplier, the PSC is currently reviewing, through Formal Case 1017, whether another entity other than Pepco should serve in this role. In 2015, approximately 24% of the District's electricity consumption—mostly residential ratepayers—went through the SOS.²³⁷ The PSC tracks which electricity suppliers provide power under the SOS contract, and the fuel mix report for the current SOS shows that in 2015 59.9% of SOS electricity came from fossil sources. Nuclear power, along with some renewable energy, supplied the remainder.²³⁸

As noted above, a PPA is an agreement between an electricity seller (i.e., supplier) and buyer (i.e., consumer), in which the latter provides the payment stream the former needs to generate electricity. For suppliers, PPA contracts provide the stream of guaranteed revenue needed to make the electricity generation feasible. For buyers, PPA contracts allow the stable procurement of clean, renewable electricity with no or minimal upfront capital costs (as compared to generating their own renewable energy), and provide a hedge against future energy market volatility, including fossil fuel price increases. When compared with non-renewable electricity procured from the PJM, PPAs that aggregate large amounts of energy could allow District customers to switch to renewable energy at a more affordable cost, while offering the District the potential to more quickly increase renewable energy and decrease the GHG emissions more effectively.

Along with a similar government instrument known as community choice aggregation (CCA), PPAs have grown significantly in recent years as a procurement tool used by both governments and industry. PPAs allow customers to procure large quantities of renewable energy at affordable, fixed prices, reducing their exposure to fossil fuel costs and price volatility. In the corporate sector, the capacity of newly signed offsite PPAs in the United States doubled from 2013 to 2014, then again from 2014 to 2015.²³⁹ In Europe, corporate PPAs nearly tripled between 2015 and 2016.²⁴⁰

²³⁷ Correspondence with DOEE staff on Aug 1, 2016.

²³⁸ Fossil fuel sources included 36.6% from coal, 23.0% from natural gas, and 0.3% from oil. Nuclear provided 35.8%. The remainder was provided by captured methane gas (0.3%), hydroelectricity (1.0%), solar (0.1%), solid waste (0.6%), wind (2.1%), and wood or other biomass (0.2%). Environmental Information for Standard Offer Service Provided by Pepco, <http://www.pepco.com/SiteCollectionDocuments/Pepco%20Fuel%20Mix%20DC%204.16.pdf>

²³⁹ The Rise of the Corporate Energy Buyer, <https://www.renewablechoice.com/blog-corporate-energy-buyer/>

²⁴⁰ Bloomberg New Energy Finance, 2016, <https://about.bnef.com/blog/corporate-renewable-energy-procurement-monthly-december/>

CCA is also on the rise: Six states have enacted CCA legislation allowing local governments to buy bulk power on behalf of large groups of residents and businesses. Four states have CCA legislation pending, and two are actively investigating the idea.²⁴¹ CCA appears to be growing the most quickly in Massachusetts and California. In southern California, for example, one research-focused NGO expects that CCA programs will, by 2020, capture more than half of the 200 GWh of electricity demand currently supplied by independently operated utilities.²⁴² For example, San Francisco's CleanPowerSF offers its customers a Green option that is 40% renewable and has lower rates than the local utility's option with 33% renewables, and a SuperGreen 100% renewable option that is cheaper than the utility's 100% renewable option.²⁴³

For its own program, the District could supply all or part of the current standard offer electricity service via a mix of aggregated renewable energy PPAs and spot market purchases—rather than continuing with its current practice of buying electricity for the SOS. These contracts would need to be phased in over three years to avoid overlap with existing SOS supply contracts.

The modelling assumes the District will meet 70% of the PPA through various renewable-energy sources, and procure the remaining 30% from the spot market. However, DOE is investigating the possibility of purchasing 100% renewable electricity through aggregated PPAs. This would allow the District shift a large portion of its electricity supply to renewable, zero-emission sources relatively quickly.²⁴⁴ Using this approach, renewable energy would become the default electricity offering; customers would be required to opt out of using it, rather than opt in. Working through the requirements of the SOS will also ensure the identification and structuring of

renewable energy contracts that satisfy the rate and load requirements of the District's customers.

Aggregated renewable-energy PPAs may reduce electricity rates below those of the current SOS, as the District Government has found with the renewable energy PPAs discussed in section 5.1.1.3. Analysis is now underway to determine the cost implications of moving such a large quantity of electricity to a new set of power purchase agreements.

Several trends are opening up near-term opportunities to procure lower-cost renewable energy PPAs. They include increases in wholesale power prices, which have climbed up from record lows. Also, between 2009 and 2017, solar and wind energy prices experienced capital cost declines of 85% and 66% respectively, and neither energy sources require ongoing and uncertain fuel costs to run. In its *2017 New Energy Outlook*, Bloomberg New Energy Finance reported that new utility-scale solar and onshore wind arrays are already cheaper than new coal plants in many jurisdictions. The company expects both will be cheaper than new natural gas plants around 2023. As such, done carefully, the District Government can both accelerate the shift to renewable energy, and lower the energy costs of residents and businesses.

If cost savings materialize, the District Government should share the savings both to reduce SOS customers' electricity costs and to increase the funding available for other renewable energy and energy efficiency programs. The PPAs will give the District Government another way of providing affordable electricity to low-income residents.

Long-term energy procurement does, however, entail risks. The District Government needs to conduct further analysis on procurement strategies and contract

²⁴¹ Community Choice Aggregation (CCA) Helping Communities Reach Renewable Energy Goals, National Renewable Energy Laboratory, September 19, 2017, <https://www.nrel.gov/technical-assistance/blog/posts/community-choice-aggregation-cca-helping-communities-reach-renewable-energy-goals.html>

²⁴² Community Choice Aggregation Expansion in California and its Relation to Investor-Owned Utility Procurements, Center of Climate Protection, May 2017, <https://climateprotection.org/wp-content/uploads/2017/06/Procurement-Report-June-21-2017.pdf>

²⁴³ Rates, CleanPowerSF, San Francisco WaterPowerSewer, accessed December 1, 2017, <http://sfwater.org/index.aspx?page=997>

²⁴⁴ In other jurisdictions, the bulk purchase and sale of renewable electricity by a municipality is referred to as community choice aggregation and must be approved by the state government. In this case, the District Government is effectively the state and municipal government, allowing the District Government to secure a PPA directly and supply it to local consumers. The NREL describes community choice aggregation (CCA) at <http://www.nrel.gov/technical-assistance/blog/posts/community-choice-aggregation-cca-helping-communities-reach-renewable-energy-goals.html>

structures to mitigate risks, maximize long-term benefits, and ensure competitive pricing to maintain an adequate customer base. Establishing suitable PPAs for the District's SOS will be complex and challenging, and must be done carefully. Planning and development may take two or three years, and the process used to establish this program may be as important a success factor as its design. In planning for and setting up the operations of the program, the District Government should consider the following, while recognizing that the process used to establish this program may be as important to its success as its design.

Limited opportunities to renegotiate PPAs:

Discussion with PPA brokers and suppliers revealed that long-term rates are typically held flat or change in a preset way that is not negotiable partway through the contract. For example, prices may adjust based on a consumer price index, but the contracts normally do not allow that adjustment mechanism to be renegotiated mid-stream. For an electricity provider, a long-term PPA often secures the financing needed to build a new renewable energy generator. This financing is tied to the anticipated revenue stream, so potential changes in that revenue stream can reduce or remove the agreement's viability. This may not necessarily be the case in all situations, but the District should not expect to be able to automatically renegotiate rates as part of long-term PPAs. Aggregation of renewable power purchases may allow the District to hedge these kinds of risks, which require further analysis.

Program phase-in: Given the risk, scale and complexity of the program, the District should consider phasing in the program over multiple years. Doing so will give the District (or the organization running the program) more experience with the procurement process, and a more nuanced understanding of supply opportunities and prices. Phasing may also open up opportunities to save money, as wind and solar prices continue to decline. The District could phase in the portion of renewable energy serving the program, starting at a quantity equal to the current SOS, and increasing in increments between now and 2032.

Multiple renewable energy options: As noted above, some local governments offer multiple renewable energy options, with one being the default service provided to ratepayers. Others have started with a commitment to be cleaner than the baseline, and increase the renewable-energy portion over time. The District could offer various levels of renewable energy, while setting one option as the default. For example, the program could offer customers two renewable-energy options:

- Somewhat higher than the baseline (the default), and
- Much higher than the baseline (e.g. 50% or 100% renewable).

This approach reduces risks associated with committing to higher renewable-energy offerings immediately, provides the District or program operator experience running the program, and improves understanding of consumer demand for different renewable energy products. Offering multiple options may make the program more complicated to manage in the short-term, but could help reduce the risk of customers defecting to lower-cost offerings.

Geographic source of supply: The District will need to determine the SOS electricity procurement boundaries. To claim the use of renewable energy and associated GHG reductions, the District likely must procure both the physical electricity and associated RECs (bundled electricity) from within the PJM Interconnection Region. Key considerations in other jurisdictions have included supply availability, transmission losses, and employment impacts. The most cost-effective wind power in PJM tends to be in the westernmost states (e.g. Ohio, Illinois, Indiana, Pennsylvania) while the most cost-effective solar tends to be in the southernmost states (e.g. North Carolina, southern Virginia). However, both regions are farther away from the District, resulting in greater transmission losses. Greater transmission losses mean more electricity must be generated to satisfy the District's consumption needs, thus increasing the cost of satisfying the SOS's program needs. The SOS is already procured from outside the District, so prioritizing lower rates will not have any negative impact on local jobs.

Treatment of RECs: As noted above, to claim the GHG emissions reductions associated with the PPA, the District likely must buy bundled electricity, which includes both the electricity and the RECs associated with renewable generation. Due to supply and demand, REC prices in some regions tend to be higher than other regions. For example, RECs in New Jersey, Pennsylvania, and Maryland historically cost between \$10 and \$20 per MWh while RECs in Texas cost \$1 to \$2 per MWh.²⁴⁵ Price fluctuations and disparities occur due to regional differences in electricity prices, renewable energy resource quality (e.g. wind speed), and supply and demand, with recent growth in supply cutting REC prices in half in recent years from the historical prices quoted above.²⁴⁶ Once it has established a geographic boundary for procurement and what constitutes appropriate supply contracts, the District will need to determine how it wants to treat RECs.

To protect ratepayers, the District may be able to participate in REC swaps or arbitrage, whereby the District sells the PJM RECs associated with its supply contract to an entity (e.g. electricity supplier) that needs them for regulatory compliance (e.g. for a renewable portfolio standard), and purchase RECs at a lower price from elsewhere.

The process to establish the program: It could easily take the District a few years to gain approval for this program and get it rolling. The following process recommendations emerged from interviews with representatives from local governments that have established or are working to establish CCA programs, as well as energy brokers and suppliers providing SOS contracts:

- Agree on goals from the outset to help ensure prompt delivery and reduce unnecessary delays. The right set of stakeholders should be involved and engaged in the process in the early stages.
- Detailed estimates of supply research and rates should address potential customer demand and willingness to pay. This could be done in collaboration with the PSC alongside, or as part of, a distribution resource plan.
- A well-informed political champion will ensure the program gets up and running as soon as possible. This person can help educate and influence other key stakeholders. This person should attend and participate in meetings with stakeholders so they can become educated on the issues, ask the right questions, and help anticipate criticisms and over-expectations of the program (e.g. immediate implementation or zero risk).
- Both critical and well-intentioned stakeholders can affect the process and prolong development time. A subject-matter expert (SME) panel and an open stakeholder engagement process could help diplomatically respond to such stakeholder challenges. During meetings (which the political champion should attend), the District and its consultants can present the findings of their research and analysis and have SMEs ask questions and provide input to the District and stakeholders. The District should start these very early on to avoid process delays and other challenges.
- Develop a well-informed business plan for the program that demonstrates how it can achieve its goals in a financially viable way and add value to the community. The business plan should lay out the overall opportunity (projected customer demand, customer profile), identify and evaluate suitable supply opportunities, and compare potential electricity rates under the program to the baseline SOS rate. The potential new rates must account for the supply and any operational program costs. Finally, the business plan should set aside a reserve requirement to demonstrate financial responsibility and help ensure the feasibility of the program.

²⁴⁵ U.S. Department of Energy, Green Power Markets, Renewable Energy Certificates (RECs), <https://web.archive.org/web/20140714234954/http://apps3.eere.energy.gov/greenpower/markets/certificates.shtml?page=1>

²⁴⁶ 2016 Wind Technologies Market Report, U.S. Department of Energy, https://energy.gov/sites/prod/files/2017/10/f37/2016_Wind_Technologies_Market_Report_101317.pdf

Next Steps

- 1 In early 2018, begin a more in-depth and collaborative analysis with industry experts and a new stakeholder group to support program design, development, and implementation.
- 2 Set a target to supply at least 70% of the Standard Offer Service through renewable energy PPAs (pending further analysis).
- 3 Aim to sign the first aggregated renewable energy purchase agreement by 2020.

CRE.3 Enact legislation that sets a maximum GHG intensity for electricity supplied to the District

Action: Pass legislation requiring energy suppliers to avoid buying electricity that exceeds a certain GHG intensity threshold (i.e., GHG emissions per unit of energy). Design legislation to steadily increase requirements over time, shifting the District's non-renewable electricity supply to less GHG-intensive generators. These requirements may also include appropriate provisions for tracking and disclosure of the electricity supply sources.

Relevance: The District's current RPS seeks to shift the District's electricity supply toward a portfolio of generators dominated by clean, renewable energy. As a complement to the RPS, the District should focus on avoiding the purchase of electricity from those generators that emit large quantities of GHG emissions per unit of energy. This will support the District in achieving its 2032 GHG reduction target by strategically eliminating the largest sources of GHG emissions in the District's electricity supply.

Details: The purpose of this recommendation is to set a maximum allowable GHG intensity for all electricity delivered to the District, and establish a timeline for compliance by electricity suppliers. It applies to all electricity supplied to the District (both new and current generators), but begins by targeting the largest sources of emissions per unit.

Regulations of this kind have already been adopted by a few jurisdictions in North America, including Ontario (Canada) and Oregon. In 2003, the Province of Ontario committed to phase out all coal-fired generation using a collaborative approach designed to address system capacity, reliability, flexibility, labor, and cost-effectiveness.²⁴⁷ Between 2003 and 2014, coal-fired electricity usage declined from 25% of Ontario's electricity to a full phase-out, while nuclear generation increased from 42% to 60%.²⁴⁸

In 2016, Oregon announced a similar program to phase out coal power by 2030.²⁴⁹ Under the same legislation, the state increased its RPS to require 50% of all electricity sold to customers to be sourced from clean, renewable sources by 2040. The State of New York announced a similar program to phase out coal by 2020, but has yet to enact legislation.²⁵⁰ Ontario and Oregon differ from the District in that they were able to regulate coal-fired electricity generated within their jurisdictions, whereas the District can only use the "power of the purse" when procuring electricity from other states. However, these experiences can provide valuable lessons to help guide the District in designing and managing this regulation.

²⁴⁷ The End of Coal, Ontario Ministry of Environment, <http://www.energy.gov.on.ca/en/archive/the-end-of-coal/>

²⁴⁸ Ibid.

²⁴⁹ Senate Bill 1547, Oregon Legislative Assembly, <https://olis.leg.state.or.us/liz/2016R1/Downloads/MeasureDocument/SB1547/Enrolled>

²⁵⁰ NY gov aims to phase out coal by 2020, The Hill, <http://thehill.com/policy/energy-environment/265786-ny-gov-aims-to-phase-out-coal-by-2020>

The District should first enact legislation requiring that all electricity purchased to serve District customers must meet a minimum GHG intensity/emissions standard. Such a measure will serve to curtail traditional fossil-fuel electricity production. In 2015, coal plants generated approximately 36.5% of electricity in the PJM territory, down from approximately 43.5% in 2014 and 44.5% in 2013.²⁵¹ It is unknown at this time how much of this was delivered to the District. In order for the emissions standard to work effectively, DOEE and the PSC should conduct analysis to explore and develop an appropriate legal framework for reasonable disclosure regarding electricity supply in order to educate and inform DC consumers and track compliance.

The District does not have electricity generation plants within its borders, and so it is not regulated by the federal Clean Power Plan (CPP) or similar regulations. A GHG emissions standard for electricity supplied to the District would, however, have a similar effect as the CPP in that both would drive down the GHG emissions intensity of the overall electricity supply. While the GHG intensity of electricity supplied from other states to the District will decline due to the CPP, enacting an emissions standard will give the District greater control over the impact of grid-cleaning efforts.

The District should also carefully consider the role of natural gas in its electricity supply, given the fuel's potential impact on the District's GHG targets. While natural gas can be less GHG intensive than coal if methane leakage is properly managed, the GHG intensity of natural gas is still much higher than renewable sources. Shifting from coal-fired generation to efficient natural gas facilities may decrease GHG emissions in the short-term; however, the useful life of natural gas facilities (30 to 40-plus years) may lock the District into fossil fuel-based infrastructure that would be incongruent with its long range target. Furthermore, natural gas combustion is a significant source of methane emissions, which warm the atmosphere much more quickly and intensely than carbon dioxide.

The District should therefore ensure that any energy supply that it needs to replace traditional fossil-fuel generation will align with its 2050 carbon neutral target. To this end, the District needs a maximum GHG intensity regulation that steadily declines, and forces a transition to lower-emissions energy sources over time. The District should additionally encourage and coordinate with the PJM states to ensure that such a regulation does not simply redirect the output of coal-fired generators into other jurisdictions. However, should these efforts founder, the District should nevertheless move forward with its own agenda in the hope that other jurisdictions will follow its lead and adopt stronger climate and energy policies.

²⁵¹ PJM System Mix By Fuel, <https://gats.pjm-eis.com/gats2/PublicReports/PJMSystemMix/Filter>

Next Steps

- 1 By 2019, begin investigating the potential impacts of the maximum GHG intensity regulation on system capacity, reliability, flexibility, and the cost-effectiveness of energy. As part of this, Direct DOEE to develop energy supply scenarios out to 2050 that achieve the District's 2050 carbon neutral target or eliminate GHG emissions altogether (in conjunction with Action CRE.1).
- 2 Conduct analysis to explore and develop an appropriate legal framework for reasonable disclosure regarding electricity supply in order to educate and inform consumers in the District.
- 3 Continue engaging the PJM states on a steady shift to less GHG-intensive resources, promoting only strategic use of natural gas to remain aligned with the 2050 carbon neutral target.
- 4 Pending further analysis, announce a plan to legislate the maximum GHG intensity
- 5 Enact legislation by 2020.

5.1.2.2 RENEWABLE ELECTRICITY SUPPLY FROM OUTSIDE THE DISTRICT

CRE.4 Develop a centralized solar information and commerce platform

Action: Create a centralized online platform, a clearing house, to provide information on and facilitate adoption of solar PV and solar thermal systems. Provide resources and information on the purchase process, available incentives and financing, and any other useful information for citizens, businesses, building owners, contractors, and developers in the District.

Relevance: This recommendation addresses the education and other resources needed to facilitate the process of learning about, paying for, and installing solar systems. As noted in the introduction of this section, the District already offers an array of incentives and programs to increase solar power accessibility and affordability. However, information is dispersed over multiple websites. A central resource that provides information on all available programs can help increase the value of existing solar incentives and programs, and eliminate potential barriers to adoption. By improving access to relevant information including potential cost savings, the District can increase the likelihood that residents and businesses will install solar systems. This will in turn help achieve the solar requirement outlined in the RPS and help the District advance toward its renewable energy targets.

Details: A single online platform will make it easier for building owners and contractors to learn about solar systems, access government incentives and programs, and connect with contractors and installers. This flexible, commerce-focused resource can be integrated with other energy-related resources and incentives to provide a complete package of information, simplifying the process of investing in renewable energy and energy efficiency. This resource should be integrated in some way with Mapdwell's Washington, DC Solar System™ mapping tool, which depicts the solar potential of every building in the District. The mapping should also attempt to account for roof age, shading, green roofs, and roof decks or other auxiliary roof uses by developing this functionality or integrating with private tools from companies such

as SolarCity or Sunrun that account for these factors. Revenues generated through the RPS's alternative compliance payments program could fund this initiative.

The DCSEU's energy efficiency website and EnergyTrust of Oregon's Incentives and financing for solar website both offer excellent examples of such platforms.^{252,253} The EnergyTrust site aggregates and plainly communicates information on incentives, tax credits, financing options, system requirements, purchase and installation steps, and available contractors, as well as a set of clearly organized links to other useful resources. Both the DCSEU and EnergyTrust also provide a means of soliciting additional information either by phone or email, including staff assigned to primarily help clients navigate the complexities of implementing energy efficiency and renewable energy.

This online platform need not be built from the ground up, nor created by the District alone. The District can work with existing sites and local partners to develop and market this solution. The DCSEU may be a good partner considering its mandate and experience managing its existing energy efficiency website. Management could also be coordinated by a similar third-party organization, or even the District itself. One important consideration is the way in which current solar developers and installers will fit into the commerce platform.

As with similar recommendations focused on buildings, the District Government should work to maximize accessibility for all residents of the District, and should work with local, trusted community organizations to engage with LMI communities, with the intent of determining how to ensure this information reaches all neighborhoods and communities.

Next Steps

- 1 Contract an organization to develop the site.
- 2 Partner with trusted community organizations to conduct offline engagement and outreach to all neighborhoods in the District.
- 3 Contact jurisdictions with existing online resource and commerce sites to derive insights on the use, perceived effectiveness, and administrative costs of these initiatives.
- 4 Explore the costs associated with website design, maintenance, and content development, as well as any staff time required.
- 5 Launch the website within the next two years.



252 <https://www.dcseu.com>

253 <https://energytrust.org/renewable-energy/incentives/solar/Residential/SolarElectric>

CRE.5 Continue to refine and implement the targeted solar proliferation strategy that has been launched under the Solar for All program

Action: Continue to refine and implement the targeted solar proliferation strategy to install solar PV and thermal systems on buildings across the District. The District has already begun work on this strategy under the Solar for All program and associated Implementation Plan.²⁵⁴

Relevance: A continuously evolving solar proliferation strategy will both support the District Government's Solar for All program, and build on its other solar policies and actions.²⁵⁵ This kind of strategy could yield tangible and immediate progress toward the District's RPS solar requirement.

Rooftop solar panels are "contagious." That is to say, when a building owner installs rooftop panels, others often soon follow atop other nearby buildings.²⁵⁶ The District's solar proliferation strategy can help to increase the number of solar PV installations, while generating citizen and business awareness and interest. It builds on ongoing work to modernize and increase the resilience of the grid, and act as a catalyst to build local workforce capacity and economic development opportunities in the renewable energy sector.

The solar proliferation strategy also aligns with several of the District's ongoing actions. The District Government is already working to increase the number of solar installations citywide to meet its goal of connecting 100,000 low-income households to solar power and cutting their electricity bills in half by 2032.²⁵⁷ This will also contribute to the District's RPS requirement of meeting 2.5% of its electricity needs using solar PV systems (or displaced by solar thermal systems) by 2023 and 5% by 2032. To achieve these RPS requirements, the District is working to identify and pursue specific opportunities to install building- and community-scale solar systems on both public and privately-owned buildings and lots.

Through December 2017, the District's Solar for All program installed over 600 kW of solar. At the time of writing this report, Solar for All has nearly 10 MW (or 10,000 kW) worth of panels in the pipeline. As of October 1, 2017, there was 63.1 MW of certified solar capacity, 41.6 MW of which is located within the District.²⁵⁸

As described in the Solar for All Implementation Plan, DOEE will implement Solar for All in five three-year phases to ensure the program is sufficiently flexible to adapt to market changes and overcome barriers. The initial implementation phase (FY17-FY19, underway) will consist of 30 to 60 MW of solar capacity, subject to funding availability. This phase will also focus on researching and developing the solutions necessary to execute large-scale projects in subsequent phases. Much of this work is being completed through strategic external and inter-agency partnerships and Solar for All Innovation and Expansion Grants.

In February 2017, DOEE announced two Requests for Applications (RFA) for \$13.2 million in Solar for All Innovation and Expansion Grants. The RFA guidelines focus on research and development and seek to address four overarching program goals: (1) to expand solar energy in the District; (2) to provide benefits to low-income residents; (3) to develop solutions

²⁵⁴ https://doee.dc.gov/sites/default/files/dc/sites/ddoe/service_content/attachments/DOEE-%20Report-%20Solar%20for%20All%20Implementation-%20Final%20for%20Transmittal.pdf

²⁵⁵ Renewable Portfolio Standard Expansion Amendment Act of 2016. <https://doee.dc.gov/service/solar-for-all>

²⁵⁶ Graziano and Gillingham, 2014, Spatial patterns of solar photovoltaic system adoption: the influence of neighbors and the built environment, <http://academic.oup.com/joeg/article/15/4/815/2412599>

²⁵⁷ Mayor Bowser Signs Renewable Portfolio Standard Bill into Law, July 25, 2016, <http://mayor.dc.gov/release/mayor-bowser-signs-renewable-portfolio-standard-bill-law>

²⁵⁸ Includes all solar systems eligible for the RPS solar requirements. Monthly Update of Solar Generator Certification, Public Service Commission of the District of Columbia, retrieved on December 21, 2016, <https://www.dcpsc.org/Utility-Information/Electric/Renewables/Renewable-Energy-Portfolio-Standard-Program/Monthly-Update-of-Solar-Generator-Certification.aspx>

to program challenges; and, (4) and to identify solutions DOEE can use to establish the most effective, predictable, and stable medium-term program. The details below can support the District in continuing to move forward with this initiative.

Details: If the District is to grow solar generating capacity on both private and District Government-owned buildings and open spaces in a short period of time, it will need a continuously evolving solar proliferation strategy.²⁵⁹ This is a direct marketing and education campaign that targets buildings suitable for solar and offers free solar assessments. Residents and businesses can self-identify as interested in the solar assessment. Program staff will then get them more information and connect them with solar installers and financing options.²⁶⁰

This campaign could be launched to coincide with the release of the District's *Centralized Solar Information and Commerce Platform*, potentially building on Solar for All's existing outreach efforts, and be implemented with and through local partners. The District may also wish to apply to the U.S DOE to use the solar proliferation strategy as a demonstration project for other U.S. cities to learn from.

The proposed solar proliferation strategy involves four phases. Before moving forward with this program, DOEE should engage with local solar-focused organizations regarding the best way to design and implement this program, as these organizations will have valuable, locally-specific knowledge, data, and information. Based on this engagement, the District Government may find the best approach to accomplishing this strategy is to release a request for proposal and procure an organization to design, manage, and implement it.

Phase 1: Identify local partners and organizations: Successfully implementing this strategy will require support from local organization and coordination with solar installers, financing providers, marketing and outreach companies, and tenant advocacy groups. Solar installers, financing providers, and marketing and outreach companies – will be important to continuing to implement the District's solar proliferation strategy and translating the implementation of the strategy into new solar adoption.

The marketing and outreach company should be procured through a competitive request for proposal based on the program's overall design and objectives. This strategy has already been launched under the Solar for All program which is currently funding nine projects under the Solar for All Innovation and Expansion Grants as well as supporting several strategic partnerships.²⁶¹ The solar proliferation strategy should build on the Solar for All program. In addition, DC PACE and a new potential DC Green Bank should be involved as financing options for future solar projects.

In addition to identifying interested solar installers, the District Government should consider using a bulk buy process to decrease panel costs. As discussed in Action EV.3, the City of Boulder, Colorado's solar panel and electric vehicle bulk buy program enjoyed considerable success in 2015, which has prompted the City to explore a second program.²⁶² Potential sources of information and support for District Government can be sourced from Boulder staff, as well as DC SUN, which has coordinated bulk buy programs, and federal staff involved in the SunShot Initiative's soft costs program.²⁶³

²⁵⁹ The proposed design of this program is partly based on the successful Solar-Check program in Osnabrück, Germany. <http://www.osnabrueck.de/gruen/klimaschutz/solardaecher/solarcheck.html>

²⁶⁰ The District Government must maintain neutrality in this process.

²⁶¹ <https://doee.dc.gov/service/solar-for-all>

²⁶² Discussion with Boulder planning staff, February 29, 2016.

²⁶³ For example: Non-Hardware ("Soft") Cost-Reduction Roadmap for Residential and Small Commercial Solar Photovoltaics, 2013-2020, <http://www.nrel.gov/docs/fy13osti/59155.pdf>. Reducing the Solar PV Soft Cost: Focus on Installation Labor, www.rmi.org/insight/reducing-solar-pv-soft-cost-focus-on-installation-labor/

Phase 2: Determine the subset of buildings to target: Next, identify a subset of the District's building rooftops with the highest solar potential and that are relatively easy to access. The primary targets should include multifamily buildings, condominium buildings, small businesses, residential solar co-ops, and nonprofit organizations. Lessons learned should be gleaned from the Solar for All Innovation and Expansion Grant Projects which are working to address barriers to accessing these types of roofs.

Several existing resources can facilitate the quick identification of initial buildings to target. For example, the District Government procured updated LiDAR data from 2015 from Mapdwell's Washington, DC Solar System™ map to estimate the solar potential of all buildings in the District.²⁶⁴ This is a good starting point, but may not take into account roof age and other limiting factors (e.g., green roofs, decks, refined shading analysis). Private solar companies like SolarCity and Sunrun offer remote analysis tools that may be able to fill in some of these gaps, if the District can work with them while still maintaining neutrality in the marketplace.

The District may or may not want to consider several other factors in determining the subset of buildings to target. While these factors can drive a more refined set of buildings to target, the value gained from the additional information (e.g., fewer site visits resulting in identification of an unsuitable building) may not be worth the time and expense required to gather this information. As such, the District should look for an existing solar mapping tool that provides some of this information, but likely should not dedicate significant time to gathering and sorting through this information. Rather, some of this information should be identified during a self-selected site visit, while other information can be layered on to the solar potential map as it is developed (e.g., related to the neighborhood-scale energy strategy, Action CRE.8, grid hosting capacity study, Action ESM.6, and location-based energy use profile, Action ESM.7). These considerations include:

- Ease of rooftop accessibility (e.g., by an aerial work platform or cherry picker).
- Capability of the building to accommodate a solar system.
- Ability of the local grid to absorb new renewable energy generating capacity (requires collaboration with Pepco) and the opportunity for new technology, including microgrids, to mitigate grid issues.
- Ability of the building to accommodate energy storage infrastructure.
- Opportunities to coordinate with upcoming construction projects to reduce installation costs.
- Alignment with the District's neighborhood-scale energy strategy (when developed).
- Expected future lifespan of buildings and roofs.
- Achieving equity goals by targeting low-income households.
- Opportunities to install larger solar systems (e.g., community-scale).
- Access needed to federal land, given the large area of land owned by the Federal Government in the District.
- Building ownership that may impact solar adoption.

Phase 3: Design and implement a targeted marketing campaign: Once the District has identified target buildings, the procured marketing and outreach company should develop a marketing campaign to directly engage with owners of identified buildings. This campaign should clearly and simply communicate the benefits of solar systems, simply explain the

²⁶⁴ Conversation with DOEE staff on February 19, 2016.

program being offered, and summarize available incentives and support. Conduct a study to determine the value proposition for tenants and property owners under different housing scenarios to tailor outreach programs. Consider implementing a “Solar Coach” program targeting rental and low-income communities to increase awareness and education on solar.

Messaging should be informed by an understanding of consumer perceptions of solar systems’ pricing, value and reliability, as well as the perceived complexity and duration of the purchase, installation, and rebate process.²⁶⁵ The District should also recruit high-profile, trusted, and credible messengers (such as the Mayor) to invite residents to participate in a momentous and meaningful program. Finally, the marketing campaign should identify opportunities to increase the impact of this initiative by publicizing, promoting, and branding installations as they occur.

The District may wish to consider expanding the targeted customer base to include citizens and businesses that do not reside in the buildings targeted for solar systems. The *Community Renewables Energy Act of 2013* provides the rationale. It allows residents and businesses to purchase electricity from solar panels on other buildings and receive credit on their utility bill as though they owned the panels.²⁶⁶ This is known as virtual net-metering, in that like conventional net-metering, it requires utilities to compensate residents and businesses for any solar they generate on-site and supply to the grid’s distribution network.

Phase 4: Facilitate installations: After a targeted building owner has received an assessment and wants to move forward, the District Government’s final step is to connect the building owners with the solar installation and financing information they need by connecting them with the appropriate organizations.

For those properties eligible for DC PACE financing, the District Government should encourage property owners to utilize the PACE financing program as a way to install solar with no out-of-pocket costs. PACE-secured PPAs represent another pathway to expanding access to solar energy for traditionally underserved segments of the real estate market, including houses of worship, nonprofit institutions, small businesses, and affordable housing.

Leveraging Lessons from repeating the Program: Any data, information, and lessons generated through this program’s implementation should be used to design future solar programs.

Next Steps

- 1 The District can begin the four phases of this recommendation immediately, but should consider aligning this work with the development of a centralized solar information and commerce platform (Action CRE.4) and the early stages of the energy delivery system modernization work recommended in section 5.2 (particularly Actions ESM.6 and ESM.7).
- 2 Select organizations to design and manage the marketing campaign and/or other phases of the strategy. Then choose organizations to perform outreach, education, technical assistance, and customer-support for underserved sectors, especially low-income, elderly, and disabled residents, as well as a range of nonprofit organizations and multifamily buildings.

²⁶⁵ Smart Solar Marketing Strategies, 2009, <http://www.cesa.org/assets/Uploads/Resources-pre-8-16/CEG-Solar-Marketing-Report-2009.pdf>

²⁶⁶ Community Renewables Energy Act of 2013, <http://dcclims1.dccouncil.us/images/00001/20130110170938.pdf>

CRE.6 Adopt solar-ready and renewable energy generation building code requirements

Action: The District should update the DC Construction Codes in the current code cycle to require new buildings and major renovations to accommodate a renewable energy generating system. It should also update codes to require building owners to meet a certain percentage of their building energy consumption via on-site renewable resources, variable by building type, size, and location. Review and remove existing regulatory barriers.

Relevance: Updating the building codes to incorporate renewable energy requirements will enable progress toward several of the District's targets. Renewable energy-ready buildings offer greater opportunity and flexibility in achieving the District's 2032 GHG target and 2050 carbon neutral target, and would also support grid resilience objectives. A requirement to install renewable energy systems on new buildings and existing buildings undergoing deep energy retrofits will also directly support ongoing efforts to study and realize neighborhood-scale energy systems (e.g. microgrids) and net-zero or net positive buildings.

The District's current building codes do not require buildings to incorporate renewable energy. Instead, developers of select building types can install a renewable energy system as one option to meet a series of sustainable building requirements. This is achieved through the District's Green Construction Code (GCC), which requires new construction projects and substantial alterations of commercial and residential buildings to incorporate a minimum number of project electives from a menu of options. Three of these options include the installation of renewable energy systems, which must provide between 5% and 20% of the building's annual energy demand. However, as of February 2016 no new construction projects had yet elected to install a renewable energy system to fulfill the GCC requirements.²⁶⁷

In addition to building codes, the District Government will need to review existing regulations, including zoning laws, to identify barriers that will impede reasonable development of on-site solar generation.

Details: of the following two approaches to increasing building renewable energy generation and consumption should be pursued.

First, the District Government should require new buildings and major renovations to be designed and built to "renewable energy-ready" design standards. These standards require that the building design takes the necessary steps (e.g. structural design, wiring, setting aside roof space, considering shading) to accommodate the installation of future renewable energy systems such as solar PV.

It is important that these updates occur via the DC Construction Codes, and not through new stand-alone legislation. Putting these requirements in the codes simplifies both implementation and compliance. The model code on which the District's Residential Energy Code is based (the International Code Council's (ICC) International Energy Conservation Code, *Residential Provisions* (IECC), already includes "Solar Ready Provisions" in Appendix RB of the 2015 IECC. The Construction Codes Coordinating Board (CCCCB) has proposed the adoption of Appendix RB into the current code update. Additionally the CCCC has proposed solar-ready code language for the DC Commercial Energy Code. These two updates will cover all building types. Using the codes to enact these requirements will simplify design requirements for architects and

²⁶⁷ Email from the District of Columbia Department of Energy & Environment staff, Feb 11 2016

engineers by enabling them to easily locate solar ready requirements, facilitate compliance by building owners by centralizing enforcement under the Solar Program located in the Department of Consumer and Regulatory Affairs (DCRA) Green Building Division, and reduce the risk of redundancy or conflicts with other parts of the code.

This requirement should be enforced under the Solar Program located in the Department of Consumer and Regulatory Affairs (DCRA) Green Building Division. This will simplify compliance and reduce the risk of redundancy or conflicts with other parts of the DC Construction Codes and laws. Under the second approach, the District could require new buildings to install a renewable energy system equal to a minimum percentage of the building's square footage, rooftop space, or projected energy demand. This action could be phased in over time, with a long-term objective of supporting the District's GHG reduction, renewable energy generation, and net-zero and net-positive building goals. The District can determine this code update's stringency and timeline via a feasibility study that would assess any cost implications and determine the appropriate approach to compliance. Such a process should engage with the local building industry to harness existing knowledge and foster broader buy-in.

New requirements should be implemented with discretion to account for barriers, such as individual sites' suitability for solar generation and storm water requirements. In these instances, the District Government should require building owners to procure the equivalent percentage of their electricity from other solar systems in the District (e.g., community solar) or purchase SRECs. The District Government should also consider how to phase in requirements for existing buildings not undergoing construction to both increase the proportion of buildings covered over time, and to allow the local building and energy industries to prepare for change. Such a phased approach should be partnered with other requirements and incentives to support the transition. For example, certain rezoning applications can be required to conduct a feasibility study for the installation of an on-site renewable energy system. Similarly, expedited building permitting can be granted where a certain percentage of energy demand is to be met with on-site renewable generation.

It may not be feasible to set a specific, universal percentage of energy that must come from on-site solar. Most large office buildings in the downtown core of DC today can typically only generate a couple percentage points of their total energy use from onsite solar, absent deep energy retrofits. Smaller buildings may be limited by height restrictions or shading from getting sufficient solar power. The impact of microgrids and district energy need also to be considered. Conversely, a one-story warehouse might easily be able to get 25% of its energy from on-site solar, and a net-zero-energy single family home should be able to get most of its energy from on-site solar. Therefore, it is important that the DCRA, DOEE, and the CCCB investigate this issue further, and that the District Government be able to customize solar requirements to particular contexts, and grant exemptions.

While emphasizing solar deployment, it is also essential to recognize the potential limitations of a building-by-building approach. The most well-intentioned owner, combined with the most progressive building code, will still fail to realize a new building's PV potential if the new power supply cannot be integrated with the local distribution system. Solving this problem requires action beyond the scale of the building—either neighborhood-scale for microgrids (see Action CRE.8), or larger areas through grid modernization (see section 5.2).

These actions follow in the footsteps of other leading jurisdictions. Vancouver (Canada) requires one- and two-family homes (duplexes) to be solar-ready,²⁶⁸ and all rezoning applicants with properties larger than two acres must conduct a feasibility study to assess the relative cost

²⁶⁸ Vancouver Building Bylaw, <https://vancouver.ca/home-property-development/green-home-building-policies.aspx>

of constructing a low-carbon thermal energy plant or connecting to one nearby.²⁶⁹ In April 2016, both San Francisco and Santa Monica announced that new residential and commercial buildings would be required to install solar PV or thermal systems based on their square footage (Santa Monica) or size of the building roof (San Francisco).²⁷⁰ Several national, state-level, and municipal governments in Europe have also adopted ordinances that require buildings to install solar thermal systems.²⁷¹

Aligning these building code updates with other initiatives will have considerable benefit, and should be informed by the results of solar proliferation and neighborhood-scale energy studies. Solar access and other renewable energy requirements should also be reviewed in the context of the District's planning process to ensure land use policies (e.g., building heights and shadow implications) and bylaws are aligned with building- and district-scale renewable energy actions. Finally, like other building code updates, the District should conduct more detailed analysis to understand the potential cost impacts and develop the specific code language.

Next Steps

- 1 Within the next year, the CCCB, DCRA, DOEE, and local building, construction, and renewable energy professionals should investigate both building code updates, include the renewable energy-ready requirement in the current code cycle, and develop a strategy to include a renewable energy mandate in the next code cycle or by adoption of a law, such as the Green Building Act.
- 2 Update DC Commercial and Residential Energy Conservation Codes to require buildings to be capable of accommodating on-site or district-scale renewable energy systems. This is currently proposed for adoption by the CCCB.
- 3 In the 2021 Code Cycle, update District Construction Codes to require buildings to install an on-site renewable energy system (unless granted an exemption), or possibly satisfy a minimum percentage of their energy demand with off-site renewable energy or renewable energy certificates. Legislation may be adopted to require an increasing requirement over time, with different goals for different building sizes and locations, but enforcement, and flexibility in implementation, should be delegated to DCRA.
- 4 Once implemented, investigate the feasibility of increasing renewable energy system requirements and expanding to include certain scales of building retrofits.

²⁶⁹ Energy sources include but are not limited to process/waste heat recovery, sewage heat recovery, geoechange (open loop, closed loop, surface water exchange), air source heat pumps, bio-energy (biomass combustion, biogasification, anaerobic digestion), and other nearby district energy systems. Vancouver Rezoning Policy for Sustainable Large Sites, <http://former.vancouver.ca/commsvcs/BYLAWS/bulletin/R019.pdf>

²⁷⁰ Santa Monica City Council Votes in Aggressive Renewable Energy Requirement on New Construction; Implementation Begins in 30 Days, <http://newsroom.smgov.net/2016/04/28/santa-monica-city-council-votes-in-aggressive-renewable-energy-requirement-on-new-construction-implementation-begins-in-30-days>
Press Release: Board of Supervisors Unanimously Passes Supervisor Wiener's Legislation to Require Solar Power on New Buildings, https://medium.com/@Scott_Wiener/press-release-board-of-supervisors-unanimously-passes-supervisor-wiener-s-legislation-to-require-693deb9c2369#.3w2l4v6v7

²⁷¹ European Solar Thermal Industry Federation, http://www.estif.org/policies/solar_ordinances/

5.1.2.3 THERMAL ENERGY SUPPLY AND DER INTEGRATION WITHIN THE DISTRICT

CRE.7 Undertake a built environment thermal decarbonization study

Action: Conduct or commission a study to determine the best way to eliminate GHG emissions from thermal energy used in the District.

Relevance: Achieving the District's 2032 GHG reduction target, or any future targets that are aligned with the *Paris Agreement*, will require a significant shift away from fossil fuels, including natural gas. Achieving its 2050 GHG carbon neutral target will require the District to eliminate fossil fuel use. Consequently, the District must transition away from equipment and technologies that currently depend on such fuels. The equipment used to heat and cool space and water in buildings is a key aspect of this transition.

Details: In the District, the energy needed to heat and cool a building's spaces and water typically represent its largest source of energy consumption and building emissions. Depending on the building's design and equipment, this thermal energy is provided through one of three means: electricity, natural gas, or fuel oil. Building thermal energy demand is also expected to increase as climate change-induced increases in summer temperatures will increase the demand for air conditioning.²⁷² As of 2013, natural gas represented approximately 40.5% of total building energy use in the District, while fuel oil represented 2.5%.²⁷³

Low carbon energy sources and systems that can be used to elicit this shift include electricity, biofuels, and low carbon neighborhood-scale energy systems. Alternative fuels derived from sources other than petroleum are less carbon-intensive, and have less GHG emissions associated. It is important to note that while electricity produces no emissions at the point of consumption, the production of electricity associated with generation can be carbon-intensive if it comes from a source such as coal (see action CRE.1). This report acknowledges that while the current carbon intensity of electricity is high, switching to electricity does currently provide the most flexibility and open up access to renewable-energy markets. As outlined in other actions related to energy supply there are multiple opportunities to reduce the carbon associated with electricity consumption.

Building heating and cooling equipment that is electric-based include electric baseboard heaters, heat pumps. Air source heat pumps (ASHP), for example, removes heat from the air to heat or cool the home, depending on the season. ASHPs can be added onto an existing heating system, or work on their own. Heat pumps are also much more energy efficient than conventional air conditioning systems. Though ASHPs are not suitable for all building types, they are increasingly meeting the needs of many buildings with the support of a small amount of electric resistance or natural gas as back-up heating power.

Given the long-term importance of building thermal energy demand to meeting its targets, the District should prioritize careful research into which systems and technologies work best. For each option, the District should assess GHG implications alongside other variables, such as energy supply availability and stability, upfront capital requirements, costs to ratepayers, and resilience (e.g., the flexibility of the system to rely on backup energy sources, or the energy efficiency of equipment to minimize overall energy demand). As optimal solutions will likely differ by building type and location, research may best be broken into multiple parts and aligned with other energy-focused work, including updates to the building code (Action NC.1),

²⁷² Task 2 Report – Vulnerability & Risk Assessment for the District's *Climate Ready DC Plan*.

²⁷³ Based on data from email from DOEE staff on January 20, 2016.

the solar proliferation strategy (Action CRE.5), and a neighborhood-scale energy strategy (discussed next in Action CRE.8). Boulder, Colorado conducted a similar strategy in 2016. The *Natural Gas Replacement Strategies for Residential Uses* modeled building energy demands, assessed replacement technologies, conducted a financial and emissions analysis, and developed a transition strategy.²⁷⁴

As a high-level framework for thermal decarbonization, this plan recommends the following prioritized list of actions as a strategic approach:

1. Phase out fuel oil as a heating source as rapidly as possible.
2. Understand which heating loads can be switched over to all-electric systems and away from natural gas based systems, and target actions accordingly.
3. For the remaining heating loads, explore how biologically derived fuels such as methane captured from agricultural processes, wastewater treatment, or landfills can service these needs.
4. Look for ways to aggregate decarbonization projects to add scale and reduce costs. This may be accomplished either through infrastructure, such as community energy systems, or through financing (Green Bank, PACE) and agreements such as collective bulk purchases.

Finally, it's important to note again that transitioning to a future where most thermal loads are being serviced via electricity is critical, and understanding how these new loads will impact electricity demand at the transmission and distribution level will be important.

Next Steps

- 1 Identify building and energy supply-focused actions that would benefit from a better understanding of how to decarbonize thermal energy in the District, and determine whether and how thermal energy research can be done to support those actions.
- 2 Assign staff from DOEE and DCRA to determine whether and how to split up the components of this research based on the energy source, thermal energy equipment, and building type.
- 3 Commission a thermal decarbonization study of one or more of the components in the previous bullet with the objective of identifying preferred energy sources and systems for different building types and outlining the steps required to begin transitioning to these new solutions.

²⁷⁴ Provided by staff at the City of Boulder on May 26, 2016.

CRE.8 Develop a neighborhood-scale energy strategy

Action: Develop a neighborhood-scale energy strategy with a focus on identifying potential supply and demand opportunities for thermal energy and electricity and preparing the District to capitalize on opportunities to install neighborhood-scale energy systems.²⁷⁵

Relevance: Neighborhood-scale energy systems can be a cost-effective way to reduce GHG emissions and energy costs, while improving energy system resilience. A neighborhood-scale energy strategy could ensure that the District can capitalize on cost-effective opportunities, as one component of larger shift to low- carbon and renewable energy. Neighborhood-scale energy also has the potential to improve resilience and efficiency by centralizing neighborhood-scale modular systems. These systems, particularly microgrids or non-wire alternatives for meeting load growth, can generate electricity and better manage load and peak demand, and could lower energy costs.

The District's current neighborhood-scale energy facilities are operated by the General Services Administration as well as several District universities.²⁷⁶ New neighborhood-scale energy systems and microgrids have also been proposed for the Walter Reed Army Medical Center and St. Elizabeth's Campus redevelopments, the SW Ecodistrict, the Kingman Park neighborhood, and dozens of other sites.²⁷⁷ DOEE is expected to release a citywide microgrid feasibility study in the near future, identifying dozens of potential microgrid opportunities. In 2016, DC Water produced an overview of its energy supply opportunities, including potential low GHG thermal energy sources such as the use of excess heat from the District's drinking water supply in summer, and the Blue Plains Advanced Wastewater Treatment Plant, in addition to opportunities for electricity generation and microgrids.²⁷⁸

DC Water is now in the process of assessing whether there is sufficient demand to develop a neighborhood-scale energy system at Buzzard Point. The District is in the early stages of putting strategies and policies in place to capitalize on these or other potential neighborhood-scale energy opportunities that may exist or emerge.

Details: Three conditions help neighborhood-scale energy facilities cost-effectively reduce GHG emissions. First, a high load density is necessary to ensure enough heating and/or cooling demand is available in a small enough area to bring down the costs of installing piping and other infrastructure necessary for thermal distribution. Second, a load diversity is a function of the time of day that energy demands are being placed on the neighborhood-scale energy system. A high load diversity is valuable because it spreads the demand more evenly across the day, thereby increasing the overall efficiency of the energy supply system and improving its financial case. Finally, both the use of low carbon energy sources, and efficiency gains from shifting to neighborhood-scale energy, can significantly reduce GHG emissions.

The DC Water study has already identified several low carbon neighborhood-scale energy opportunities. While most these are expected to be used to satisfy DC Water's own energy requirements, DC Water has identified up to 200 MW of thermal energy available from wastewater that may be able to supply buildings at locations around the city.^{279, 280} The District may wish to work with DC Water to explore where this wastewater thermal supply can be matched with nearby demand. This information should also be supplemented by a District-led study to identify potential geothermal and hydrological sites, opportunities for low carbon biomass and other waste-to-energy facilities, and sources of waste heat. As with solar electricity opportunities, access to federal land could afford additional opportunities.

²⁷⁵ The term "neighborhood-scale energy systems" refers to what are commonly called "district energy systems." The term neighborhood-scale is used to avoid confusion between district and District, where the latter refers to the District of Columbia.

²⁷⁶ 2014 Comprehensive Energy Plan for the District of Columbia (unreleased), pp.36-37, 159.

²⁷⁷ Sustainable DC, 2012, p.19; DOEE 2016 Microgrid Report (unreleased).

²⁷⁸ DC ENERGIZED, DC Water's Energy Opportunities, DRAFT 2-11-2016, unreleased as of March 21, 2016.

²⁷⁹ Communication with DOEE staff, March 29, 2016.

²⁸⁰ DC ENERGIZED, DC Water's Energy Opportunities, DRAFT 2-11-2016, unreleased as of March 21, 2016

While not every opportunity can or should be pursued, a map and summary of potential low carbon neighborhood-scale energy sources will be a useful resource for District staff involved in community planning, energy supply system planning, infrastructure planning, and retrofit program activities. An understanding of these opportunities may affect how certain decisions are made to increase neighborhood-scale energy demand and reduce the capital cost to build the system (e.g., community planning to increase demand, adjusting infrastructure planning timelines to decrease costs).

While studying the availability of local zero emission thermal energy supplies, the District should investigate new renewable electricity generation that can be incorporated at or near the same sites. Integrating neighborhood-scale thermal energy and electricity generation allows the District to identify greater possible energy efficiency improvements and GHG reductions that could not be realized by a sole focus on thermal energy, and can lead to microgrids that support the modernization of the District's energy delivery system and increase the electricity grid's ability to handle new distributed energy resources (energy delivery system modernization is discussed in section 5.2). Two such microgrids currently under development have been included in the modeling done for the Plan.²⁸¹

The bulk of the neighborhood-scale energy strategy should focus on understanding potential demand – both load density and load diversity – and determining how the District can support the implementation of neighborhood-scale energy systems. The strategy can inform planning and policy making activities (e.g., utility infrastructure planning, land use planning, building and energy codes and bylaws, and related regulations) to ensure that the District is prepared to capitalize on neighborhood-scale energy opportunities and alternatives to traditional utility strategies as they come available, especially in the neighborhoods experiencing load growth. Importantly, the District needs to ensure that neighborhood-scale energy systems are designed to achieve increasing improvements in energy efficiency and conservation, and resiliency. The neighborhood-scale energy strategy should be led by DOEE, involve DC Water, and engage relevant internal and external stakeholders. These stakeholders may include the PSC, Department of General Services, Office of Planning, Building Code Advisory Committee, Building and Land Regulations Administration, DC Water, Pepco, Washington Gas, Office of Budget and Planning, Economic Development and Planning, District Department of Transportation, the DC Chamber of Commerce, the DC Building Industry Association, and others. Participation by the District Department of Transportation can help align infrastructure planning and development activities to share construction costs.

The team developing a neighborhood-scale energy strategy could consider the following:

- Identify thermal energy and electricity demand opportunities based on new construction, anticipated growth, and current thermal energy demand compatible with neighborhood-scale energy.
- Perform a strengths, weaknesses, opportunities, and threats (SWOT) analysis of the potential role of the District with regards to the promotion and proliferation of low-carbon neighborhood-scale energy systems.
- Work with the PSC (including through Formal Case 1130), local utilities, the Office of Planning, and the Zoning Commission and the DC Council to establish a modernized regulatory and legislative framework to allow for appropriate development of viable neighborhood-scale systems. These would include microgrids that could accommodate various scenarios and maximize the benefits of on-site energy assets to consumers and the grid.

²⁸¹ The model incorporates existing estimates of the GHG reduction potential of the Walter Reed and St. Elizabeths sites, that the District is actively engaged in maximizing cost-effective microgrid opportunities. With this additional information, the next iteration of the Plan can better quantify and incorporate these opportunities.

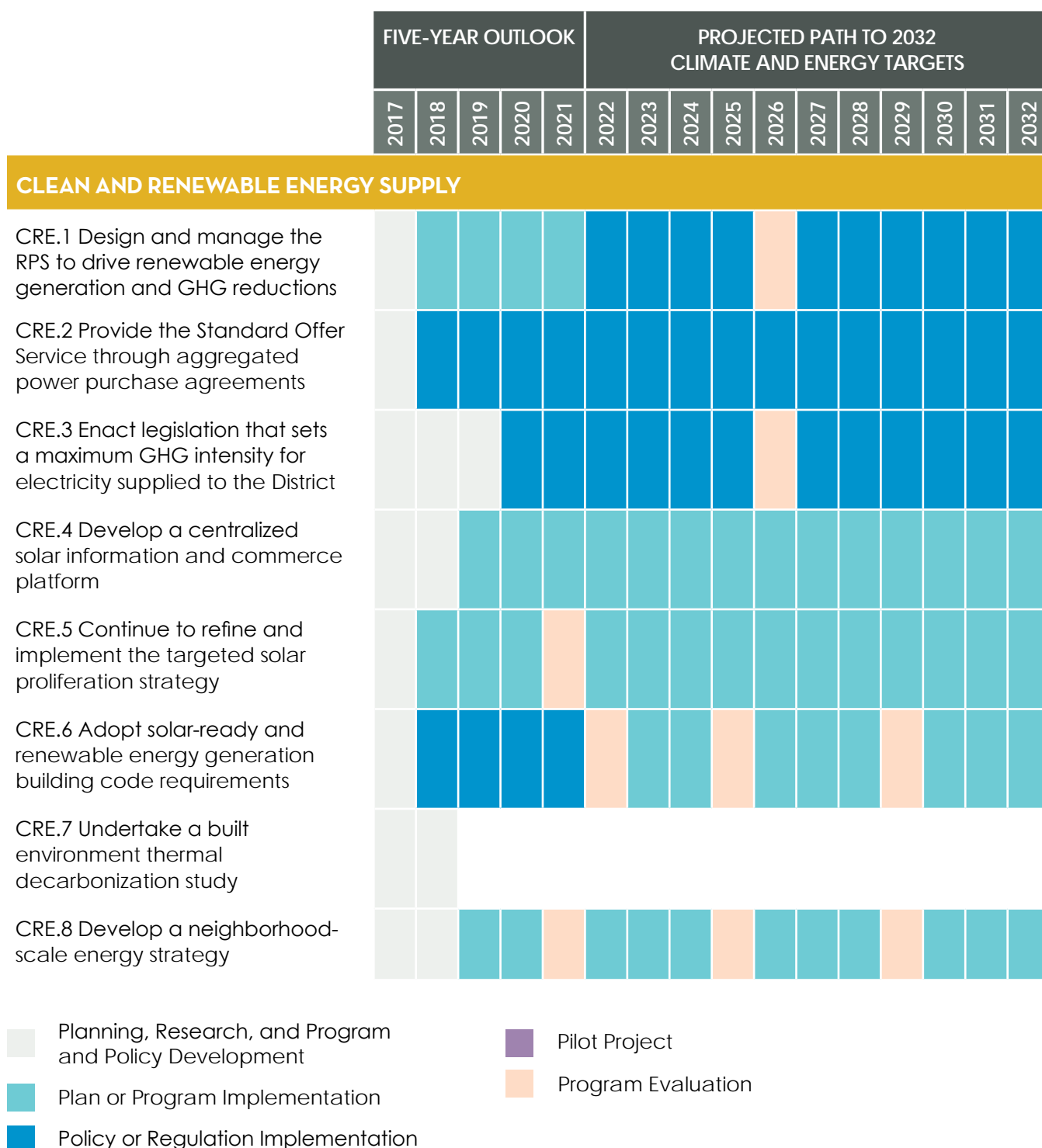
- Investigate DER-driven alternatives to traditional utility solutions for meeting load growth in neighborhoods or substation zones.
- Incorporate neighborhood-scale energy strategies into the District's Comprehensive Plan amendment process, specifically the Environmental Protection, Infrastructure, and Resilience Elements. Establish a requirement that developments in certain categories/sizes and zoning overlay districts must undertake a feasibility analysis for neighborhood-scale energy systems, including microgrids.
- Require all major transfers of public land to private ownership or mixed finance structures to assess neighborhood-scale energy options for resiliency and sustainability.
- Identify policy reforms required to remove barriers, enhance support, and expand the future market for neighborhood-scale energy (including infrastructure costs, green building policies and programs, utility policies and incentives, and District Government policies regarding specific energy sources, e.g., regarding biomass).
- Investigate phasing strategies to facilitate the long-term implementation of neighborhood-scale energy systems that incorporate both thermal energy and electricity supplies. These should consider future infrastructure planning (to reduce total costs), development plans, and anchor loads.
- Use District Government buildings as anchor tenants to improve the financial case.
- Develop a memorandum of understanding between DOEE and DC Water regarding ongoing collaboration to identify and develop neighborhood-scale energy opportunities.
- Assemble a formal interdepartmental or interagency team focused on neighborhood-scale energy.
- Calculate energy and GHG emission performance implications of one or more neighborhood-scale energy systems compared to a business as usual scenario.
- Select specific neighborhoods with a high potential for thermal and electric energy demand and low carbon supply. Recommend feasibility analyses and other planning studies for further investigation.
- Provide an extension service that offers technical expertise and planning support to private developers, neighborhood associations, and government agencies unfamiliar with the benefits and the complexities of neighborhood-scale energy approaches, including microgrids.
- Identify a pilot project and developing a framework for developing projects (e.g., through a public-private partnership, a balance of ownership and operation responsibilities between the District and DC Water, etc.).
- Investigating the value of applying a carbon price to thermal energy sources that result in GHG emissions.

Next Steps

- 1 In 2018, begin discussions with DC Water regarding the opportunity to collaborate on neighborhood-scale energy initiatives, with a particular focus on wastewater thermal.
- 2 The District Government should actively participate in near-term pilot projects, in parallel with the suggestions of Action ESM.11 related to grid modernization pilot projects.
- 3 Add amendments to the Comprehensive Plan to emphasize neighborhood-scale energy strategies, and require any project over 500,000 gross square feet with a zoning overlay district to evaluate neighborhood-scale energy and microgrid opportunities in planning.
- 4 Within the next two years, direct DOEE staff to assemble a group of key neighborhood-scale energy stakeholders (for both thermal and electric energy) and investigate and map other low carbon neighborhood-scale energy sources, assess neighborhood-scale energy demand potential, evaluate the role the District can play in facilitating neighborhood-scale energy opportunities, and conduct the planning and policy making necessary to ensure it is able to capitalize on emerging neighborhood-scale energy opportunities that align with its long-term targets.
- 5 Once the strategy is developed, initiate any action necessary to ensure planning and policy tools can support and will not hinder neighborhood-scale energy development.



5.1.3 CLEAN AND RENEWABLE ENERGY SUPPLY ROADMAP



5.2 ENERGY SYSTEM MODERNIZATION

5.2.1 AN OVERVIEW OF ENERGY SYSTEM MODERNIZATION

5.2.1.1 CURRENT ENERGY SYSTEM PRESSURES

As discussed in Chapter 2, a much higher proportion of the District's total electricity supply must be shifted to renewable energy to meet the District's targets, both from outside and within the District. This will require strategically phasing out fossil fuels, then coupling with efficient electricity use and peak load reductions.

At the same time that the District pursues these climate and energy targets, increasing pressures are being placed on the electricity grid. Aging infrastructure will require ongoing maintenance and costly investments to ensure its continued reliability. Indeed, Pepco in its 2016 rate case projects an expenditure of \$1.52 billion in new capital projects between now and 2020 to ensure reliability.²⁸² While these investments are costly, avoiding them will see the overall reliability of the grid decline, while electricity costs for consumers will increase.^{283,284}

The grid is also challenged by extreme weather and flooding events associated with climate change. A District- based Vulnerability and Risk Assessment recently found that major District infrastructure assets, including electric substations and Metrorail, will be vulnerable to both extreme heat events and periodic flooding as early as 2020. The consequent impact on these important pieces of infrastructure will be significant for the businesses, governments, and residents that depend on this infrastructure.²⁸⁵ To address these concerns, the District has made resilience of energy supply system a key priority. This includes ensuring the ongoing reliability of the electricity system, as well as its ability to resist, respond to, and recover from shocks or attacks on the system – whether these are natural (e.g., extreme weather, animals) or man-made (e.g., physical or cyberattacks).

To this end, the *Sustainable DC Plan* has set a goal to reduce the total number of annual power outages to between zero and two events of less than 100 minutes per year.²⁸⁶ A second goal has been established to improve the District's human preparedness and physical adaptability to future climate change, with a particular focus on the District's energy infrastructure.²⁸⁷ These goals are addressed in further depth in the *Climate Ready DC Plan* (2016), which outlines several actions focused particularly on energy delivery system resilience.

Further, as in most jurisdictions, the District's current electric grid is currently inefficient in terms of system utilization, as it was built to support the peak electricity demand that occurs for a short period of time each year. For the remainder of the year, the grid is underused and therefore inefficient. With overall grid utilization at approximately 53%, there is a significant opportunity to improve the cost-effectiveness of the District's energy delivery system through a shift in electricity grid infrastructure and operations.²⁸⁸ This shift can be supported by distributed energy resources (DER), but DER must be successfully integrated into the grid. More discussions on DER are provided in the next section.

²⁸² Formal Case 1139 – Application, Direct Testimony and Exhibits of Potomac Electric Power Company Witnesses Velazquez and McGowan

²⁸³ Reliability refers to the ability of the grid to deliver high quality power consistently.

²⁸⁴ Failure to Act: Closing the Investment Gap for America's Economic Future, American Society of Civil Engineers, <http://www.infrastructurereportcard.org/wp-content/uploads/2016/05/ASCE-Failure-to-Act-Report-for-Web-5.23.16.pdf>

²⁸⁵ Vulnerability and Risk Assessment Report (p.4) developed as part of the development of the District's Climate Ready DC Plan.

²⁸⁶ Sustainable DC Plan, 2012

²⁸⁷ Sustainable DC Plan, 2012

²⁸⁸ Grid efficiency figure sourced from correspondence with DOEE staff on July 13, 2016.

5.2.1.2 THE RISE OF DISTRIBUTED ENERGY RESOURCES

The past several years have seen the growing adoption of new energy technologies that interact with the grid in more complex ways known as distributed energy resources (DER). DOEE broadly defines DER in a way that accounts for both the technologies themselves, as well as the multiple aspects of the energy delivery system with which these technologies interact. DER technologies can both increase renewable energy generation and support more efficient and cost-effective management of the energy delivery system. DER includes energy efficiency (both at the levels of consumers and the grid), demand response, distributed storage, distributed generation (e.g., solar panels, thermal energy recovery systems), microgrids, and electric vehicles.²⁸⁹ DER will play an important role in achieving the District's 2032 GHG reduction, energy use reduction, and renewable energy generation targets. Improvements in technology, reductions in cost, and increases in GHG emissions policy have driven significant growth in the demand for DER over the past several years. Continuing this growth will require innovative, strategic investments in infrastructure and operational capabilities to meet existing and new types of demands placed on the grid by these new technologies, while capitalizing on the opportunities DER technologies offer.

Integrating DER into the existing grid presents new challenges. While DER technologies can be connected to different parts of the grid, the District's existing grid infrastructure is based on a model of centralized, large-scale electricity generation (e.g., hydroelectric dams, coal-fired power plants, and nuclear power plants) that is transmitted through regional distribution networks to end-users. Integrate high quantities of DER technology into the existing grid will impact grid performance and operation. For example, electricity generated at customers' residences can affect the performance of both the distribution network and the broader transmission network, as well as the way the centralized fleet of generators may be deployed to meet energy demand.²⁹⁰ Such interactions can lead to reliability problems, and challenge existing utility models, regulatory structures, and decision-making processes around the design and operation of the grid.²⁹¹ As such, utilities and regulators should consider current and future growth in DER when planning or making investment or regulatory decisions; otherwise, they risk making costly grid investments that are incompatible with the future operation of the grid.

The growing focus on DER and distribution planning also offers considerable benefits over traditional energy system planning and management. Increases in DER can help reduce the need for traditional investments in the grid and ultimately lower rates for customers. In May 2016, the California-based Pacific Gas & Electric utility reported that the growth in DER, energy efficiency, and demand response measures have rendered \$192 million in approved transmission improvements unnecessary.²⁹² This trend is likely to continue: the cost of DER is declining as technology improves; soft costs (e.g., installation costs) are declining as business model improves; and increased production improves economies of scale. At the same time, the price of electricity from wind and solar photovoltaic (PV) generation has fallen dramatically over the past decade, making solar and wind the most affordable source of power in some areas even when compared to fossil fuels.²⁹³

²⁸⁹ Comment on the Scope of the Proceeding by the District of Columbia Government (p.2), Formal Case 1130, District of Columbia Public Service Commission.

²⁹⁰ Electric Power Research Institute, 2015, *The Integrated Grid: A Benefit-Cost Framework* (p.xviii).

²⁹¹ QER Report: Energy Transmission, Storage, and Distribution Infrastructure (p.S-14), 2015, Quadrennial Energy Review

²⁹² Californians Just Saved \$192 Million Thanks to Efficiency and Rooftop Solar, May 31 2016, Greentech Media, <http://www.greentechmedia.com/articles/read/Californians-Just-Saved-192-Million-Thanks-to-Efficiency-and-Rooftop-Solar>

²⁹³ Solar Energy Is Cheapest Source of Power in Chile, Deutsche Says, Nov 4 2015, Bloomberg, <http://www.bloomberg.com/news/articles/2015-11-04/solar-energy-is-cheapest-source-of-power-in-chile-deutsche-says>
"€0.02 Solar is Quite Possible." <https://cleantechnica.com/2016/05/30/02-cent-solar-possible/>

DER can facilitate peak demand reductions and obtain associated cost savings. Peak demand refers to the maximum quantity of electricity a customer demands at a given time. Peak demand often results when a business is using all of its equipment, or when residents demand high amounts of electricity for cooling on a hot summer day. An electric grid must be able to supply enough power to satisfy peak demand, however high and for however long. Certain DER technologies can reduce peak demand, which will help the grid operator and consumers to predict and adjust their energy demand, thereby saving significant costs.

Local energy storage technologies also allow customers to receive a larger portion of their electricity from nearby generators (e.g., solar panels on their roof or in their neighborhood), thereby gaining efficiency through reduced distance that electricity must travel via transmission and distribution lines. This in turn decreases the need for additional power lines and associated investments, reducing line losses.²⁹⁴ By extension, these increases in efficiency reduce the need for additional generating capacity and associated grid infrastructure, lowering costs for customers.

Finally, DER can accelerate the adoption of localized renewable energy generation. Consider that 99.2% of new electricity generation capacity added to the U.S. grid in Q1 of 2016 came from renewable sources, more than half of which was distributed solar.²⁹⁵ A combination of DER and modernized grid equipment will help ensure affordability, efficiency, reliability, resilience, and security of the District's electricity.

In sum, the various pressures and changes facing the grid require the District to engage in a process of changing, improving, and upgrading the energy delivery system, and particularly the electricity system, or what is broadly referred to as grid modernization. Making these changes in a timely and thoughtful way will be crucial, as the inherent longevity of grid infrastructure means that any near-term decisions will influence the composition and function of the grid for decades to come. This section of the Plan identifies electricity system modernization actions necessary to ensure the District's energy delivery system can support deep GHG reductions and capitalize on the opportunities presented by DER while meeting customers' needs both now and in the future.

5.2.1.3 THEORY OF GRID MODERNIZATION

Grid modernization, or electricity system modernization, can be summarized as the strategic process of assessing and updating grid infrastructure, utility business models, and regulatory structures to achieve a balance of an affordable, sustainable, and resilient energy delivery system.²⁹⁶ Grid modernization is critical to enabling widespread DER integration and helps jurisdictions improve reliability and resilience, lower GHG emissions and energy use, increase system flexibility, ensure security, and maintain affordability.²⁹⁷

A key feature of this description is the *integration* of DER into the grid. To maximize the value of DER and ensure it has a positive effect on the operation of the grid; DER cannot simply be connected to the grid. Rather, DER must be integrated through adjustments in other

²⁹⁴ Energy Information Administration, 2016, How much electricity is lost in transmission and distribution in the United States?, <https://www.eia.gov/tools/faqs/faq.cfm?id=105&t=3>

²⁹⁵ Renewables = 99% Of New Electricity Capacity In Q1 2016 In USA (CleanTechnica Electricity Reports), May 31 2016, <http://cleantechnica.com/2016/05/31/renewables-99-new-electricity-capacity-q1-2016-usa/>

²⁹⁶ Although the term "grid modernization" is more commonly used, the District Government and Public Service Commission use the term "electricity delivery system modernization" to explicitly acknowledge the fact that the modernization process required changes to regulatory and market structures in addition to grid infrastructure. Both terms mean the same thing in the Plan, and "grid modernization" is often used for brevity.

²⁹⁷ Grid Modernization Initiative, October 22, 2015, Presentation by Kevin Lynn of the Office of Energy Efficiency and Renewable Energy at the U.S. Department of Energy.

infrastructure, utility operations, and regulatory structures.²⁹⁸ This holistic grid modernization approach to DER integration becomes increasingly important as the supply and use of DER increases.

Although the specific process through which jurisdictions will modernize their grid is not yet fully understood, one particular framework for the grid modernization process has been widely cited by jurisdictions in more advanced stages of grid modernization.²⁹⁹ The framework outlines a three-stage evolutionary process driven by higher levels of DER adoption:

Stage 1: Grid Modernization involves a low level of DER adoption that can be accommodated with existing distribution systems, and without any materials changes to infrastructure or operations.

Stage 2: DER Integration occurs when DER adoption levels reach a threshold that requires enhanced functional capabilities to ensure reliable distribution system operation and capture system benefits. Based on current DER adoption experiences, this appears to occur when DER adoption reaches approximately 5% of distribution grid peak loading system-wide.

Stage 3: Distributed Markets is a conceptual stage that results from a combination of high DER adoption and policy decisions to create distribution-level energy markets to facilitate distributed (e.g., peer-to-peer) transactions.

Most U.S. grids, including the District's, are in Stage 1. However, DER adoption levels and public policy decisions in California and Hawaii place them in Stage 2 of the process, with New York State close behind. These three jurisdictions (as well as Germany) can provide valuable learning opportunities for the District and are referenced throughout the recommended actions below.

5.2.1.4 POLICY OBJECTIVE

To achieve the District's objectives and drive the necessary increases in DER adoption, the District Government should adopt the following language in establishing a specific policy objective for this critical work:

The District of Columbia will make a phased and strategic transition to a 21st Century energy supply system that supports the District in achieving its priorities as set forth in the Sustainable DC Plan. The modernized energy delivery system will be designed, operated, and regulated to empower District residents and businesses, while supporting innovation in energy services through advanced distributed energy resources and dynamic energy management capabilities. The system will be highly efficient, resilient, reliable, secure, flexible, and deliver affordable power to customers.

²⁹⁸ Electric Power Research Institute, 2015, *The Integrated Grid: Realizing the Full Value of Central and Distributed Energy Resources* (p.33).

²⁹⁹ De Martini and Kristov, 2015, *Distributed Systems in a High Distributed Energy Resources Future: Planning, Market Design, Operation and Oversight*

5.2.1.5 EXISTING DISTRICT GOVERNMENT ACTIONS

The District is at an early stage in the process of modernizing its energy delivery system. From a regulatory standpoint, this process is being driven by the PSC's Formal Case 1130 (FC1130), *In the Matter of the Investigation into Modernizing the Energy Delivery System for Increased Sustainability (MEDSIS)*. FC1130 was initiated in June 2015 with the objective to "identify technologies and policies that can modernize our energy delivery system for increased sustainability and will make our system more reliable, efficient, cost-effective and interactive."³⁰⁰ DOEE has been engaged in this process through the submission of formal comments, presentations at workshops, and attendance at meetings. This ongoing proceeding will remain a critical early component of the District's long-term transition to a modernized energy delivery system. The recommended actions in this section should be integrated with DOEE's intervention in FC1130, as a component to build experience and capacity of the District Government with respect to these issues. MEDSIS town hall meetings are conducted in interest of working in collaboration with all stakeholders and interested citizens, and this outreach should continue and expand to further engagement of stakeholders, particularly low income communities and tenant advocacy groups.

Other related actions taken by the District Government include the near-complete deployment of advanced metering infrastructure (e.g., smart meters) and the District's climate change adaptation plan, the *Climate Ready DC Plan*.³⁰¹ As discussed in Action ESM.9 below, the extensive deployment of advanced metering infrastructure can support grid modernization by providing the District with valuable data with which to assess grid functioning, plan for DER integration, support more advanced energy demand management, and identify opportunities for pilot projects. This will be an important part of effectively managing the long-term transition to a modernized grid while maintaining reliability and resilience. The District's *Climate Ready DC Plan*, and related *Vulnerability and Risk Assessment Report*, will provide a crucial layer of information that will help to ensure that planning efforts and investment decisions are cognizant of the anticipated effects of climate change on the grid and the grid's role in the functioning of the city more generally. The *Climate Ready DC Plan* also lays out a series of resilience-focused actions, many of which can support the District's grid modernization efforts. The District Government should thus align efforts coming out of both the *Clean Energy DC* and *Climate Ready DC*.

³⁰⁰ Public Service Commission Order 17912.

³⁰¹ Smart meter deployment figures found in Fact Sheet, Pepco, <http://www.smartgrid.gov/files/Pepco-District-Columbia-Smart-Grid-Project-2015.pdf>

5.2.2 RECOMMENDED ACTIONS

As noted above, modernizing the District's grid infrastructure, utility model, and regulatory structure will be fundamental to the achievement of the District's long-term climate and energy targets. It will affect the District Government's decision-making about buildings, electric transportation, and, most fundamentally, the transition toward a low carbon energy supply system dominated by renewables. As such, grid modernization actions will both affect and be affected by the pursuit of actions in the other sectors outlined in this Plan. The District Government must therefore work to align the actions recommended here with those in the other sections, as well as those discussed in the Climate Ready DC Plan.

5.2.1.5 POLICY OBJECTIVE

ESM.1 Define a vision of the future grid and characterize the stages of grid modernization

Action: Create a vision of the District's future electricity system as a major component of the District's energy delivery system. Use this vision to define the capabilities and characteristics the grid will require, and characterize the transition required to achieve this vision.

Relevance: As outlined in section 5.2.1.3, modernizing the electricity system requires a phased transition through three stages to a loosely-defined future state. To guide their efforts in a strategic manner, the District must take steps to envision what this future electricity grid can and should look like. To some extent, this process is already underway via the PSC's FC1130. However, it is important to include it here to emphasize its importance and to provide guidance by drawing on the experiences of other jurisdictions and existing grid modernization literature.

Details: Planning and implementation work done by Germany, New York State, California, Hawaii, and other jurisdictions clearly indicates the significant value in modernizing the electricity grid and moving toward a more flexible and dynamic decentralized electricity system.³⁰² As such, the District Government should move swiftly beyond the evaluation of the potential value of a modernized grid and proceed to planning and implementation. As a first step, the District Government should clearly establish, reiterate, and quantify the District's objectives for grid modernization as they relate to its 2032 GHG reduction, energy use reduction, and renewable energy utilization targets, as well as the areas of efficiency, resilience, reliability, security, flexibility, and interactivity. With these objectives clarified, the District can begin to envision the future state of the electricity system, and its fit with other major components of the District's energy delivery system, and characterize the process to achieve it.

In developing a grid vision, the District Government should conduct stakeholder engagement around the following questions:

- What functions must the future grid be capable of providing?
- What is the emerging vision of the distributed market structure? Are there multiple distinct options?
- What are the roles of key actors in the future system (e.g., market actors, regulators, distribution system operator, customers)?

³⁰² e.g., Staff White Paper on Benefit-Cost Analysis in the Reforming Energy Vision Proceeding, Jul 1 2015, New York Department of Public Service, [http://www3.dps.ny.gov/W/PSCWeb.nsf/96f0fec0b45a3c6485257688006a701a/c12c0a18f55877e785257e6f005d533e/\\$FILE/Staff_BCA_Whitepaper_Final.pdf](http://www3.dps.ny.gov/W/PSCWeb.nsf/96f0fec0b45a3c6485257688006a701a/c12c0a18f55877e785257e6f005d533e/$FILE/Staff_BCA_Whitepaper_Final.pdf)

- What market, technology, demographic, and environmental trends and developments are likely to influence the performance of the grid and how (e.g., increased DER adoption, climate change impacts)?
- How can potential market power concerns be mitigated?³⁰³

Similarly, the District Government must define the three transition stages of *Grid Modernization*, *DER Integration*, and *Distributed Markets* (described in section 5.2.1.3) as they relate specifically to the District's electricity system.³⁰⁴ Guiding questions that can help clarify the grid modernization process include the following:

- What is required to enable key actors to operate effectively in the envisioned market?
- How can customers and distributed energy suppliers be best empowered? How may the current market structure inhibit empowerment?
- How does each envisioned phase translate to changes at the different scales of the electricity grid: buildings, neighborhoods (feeders), the city, and outside the District?
- What may change about the interface between the distribution and transmission networks (e.g., potential role of high voltage direct current transmission)?

Following the example of New York State, the District Government should consider defining a small set of critical path features to provide clarity on the general processes the District must pursue. These features will assist the District in its evaluation of the current state of infrastructure, utility models, and regulatory structures (see related actions in section 5.2.2.2). As the grid vision continues to evolve and specific actions become clearer through additional research, analysis, and piloting, a set of critical path features will also help the District Government to identify no regrets actions for the design of near-term efforts (see section 5.2.2.3). Examples from New York State include:

- Increasing the DER asset base.
- Building market and customer confidence in the expanded role of DER.
- Removing key barriers to DER adoption.
- Gaining experience and capabilities to support the implementation of the modernized electricity system platform and distributed markets.

To guide the definition of both a grid vision and the specific transition stages, the District Government should consider applying principles that have been developed to guide other jurisdictions. Such principles set a tone for the overall grid modernization process and can improve stakeholder confidence in their ability to engage in it. Examples include the four principles found in the *More Than Smart* initiative based in California as well as the five principles proposed to guide New York's *Reforming the Energy Vision* proceedings.^{305,306} These include principles focused on collaboration, transparency, standardization, action-orientation, planning processes, roles, open access, flexibility, and scenario-based planning. However, as nearly all electricity is generated outside the District's borders, the District will need to define a set of principles most appropriate to its context.

³⁰³ Adapted from Developing the REV Market in New York: Department of Public Service Staff Straw Proposal on Track One Issues, Aug 22 2015, <http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId=%7bCA26764A-09C8-46BF-9CF6-F5215F63EF62%7d>

³⁰⁴ U.S. Energy Information Administration, District of Columbia Electricity Profile 2014, Table 1: 2014 Summary Statistics, <http://www.eia.gov/electricity/state/districtofcolumbia/>

³⁰⁵ More Than Smart: A Framework to Make the Distribution Grid More Open, Efficient and Resilient (pp3-4,11), 2014, Greentech Leadership Group, <http://morethansmart.org/wp-content/uploads/2015/06/More-Than-Smart-Report-by-GTLG-and-Caltech-08.11.14.pdf>

³⁰⁶ Developing the REV Market in New York: Department of Public Service Staff Straw Proposal on Track One Issues, Aug 22 2015, <http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId=%7bCA26764A-09C8-46BF-9CF6-F5215F63EF62%7d>

Next Steps

- 1 Develop a District grid vision and characterize the expected transition stages by 2019.
- 2 Review and update the grid vision during the development of the next iteration of *Clean Energy DC*, as needed.

ESM.2 Adopt a framework for valuing distributed energy resource costs and benefits

Action: Develop or adapt an existing benefit-cost analysis framework for the consistent and transparent evaluation of DER additions and updates to the grid.

Relevance: In moving toward a grid planning model that explicitly and increasingly focuses on DER, governments and utilities will need to reevaluate their approach to investment decisions. To ensure investments in infrastructure will provide value throughout their lifetime (i.e. decades into the future), decision-makers need appropriate methods to comprehensively value the private and societal costs and benefits of the existing distribution grid, grid enhancements, and DER integration.

Details: A benefit-cost analytical framework should provide a consistent and transparent approach to evaluating all potential DER and grid modernization investments. It must be capable of accounting for the value of making progress toward each of the District's grid objectives (e.g., efficiency, flexibility, resilience) and focus on the short- and long-term impacts of DER integration. Among other things, such a framework must also be capable of accounting for:

- Current grid capabilities.
- Opportunities to defer or avoid infrastructure costs.
- Cross-dependencies between technologies.
- Anticipated capability needs of the future (Stage 3) grid.
- The equity impacts of costs and benefits.
- The locational value of DER, including a valuation of integrating DER in a specific location on the distribution grid, and its ability to support real-time operational services, reduce peak demand, and defer other infrastructure investments.³⁰⁷

In addition to accounting for the items above, the District's framework should also account for potential costs and benefits to LMI communities. Already, LMI communities are exempt from paying electricity distribution costs, which account for approximately 25% of a residential utility bill. As a more economically vulnerable population, LMIs should be explicitly considered when developing the strategies, policies, and analytical frameworks that will guide DER integration and expansion in the decades ahead.

³⁰⁷ De Martini and Kristov, 2015, Distributed Systems in a High Distributed Energy Resources Future: Planning, Market Design, Operation and Oversight

Several examples of benefit-cost frameworks have been developed that can provide a template for the District, including:

- Advanced Energy Economy Institute's *Benefit-Cost Analysis for Distributed Energy Resources*³⁰⁸
- California's proposed *Locational Net Benefit Analysis*³⁰⁹
- The *Distributed Energy Resource Avoided Cost Calculator (DERAC)*³¹⁰
- New York's proposed *Benefit-Cost Analysis (BCA) Framework*³¹¹
- EPRI's *The Integrated Grid Benefit-Cost Framework*³¹²
- Analysis Group's *The Value of "DER" to "D"*³¹³

Once this framework has been developed, the District Government should establish a clear set of procedures to evaluate any DER proposed by the District Government, utilities, or other energy supply system stakeholders. The benefit-cost framework should be used to inform the design of policies, programs, and targeted outreach (e.g., the solar proliferation strategy in Action CRE.5).

Next Steps

- 1 Collaborate with the PSC and stakeholders in 2018 to develop a framework through which to evaluate DER.
- 2 Review and revise the framework as needed when updating the grid vision during the development of the next iteration of *Clean Energy DC*.

³⁰⁸ 2014, <https://www.aee.net/aeei/resources/benefit-cost-analysis-der.html>

³⁰⁹ 2016, <http://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M161/K474/161474143.PDF>

³¹⁰ 2011, www.cpuc.ca.gov/WorkArea/DownloadAsset.aspx?id=9440

³¹¹ 2015, [http://www3.dps.ny.gov/W/PSCWeb.nsf/96f0fec0b45a3c6485257688006a701a/c12c0a18f55877e785257e6f005d533e/\\$FILE/Staff_BCA_Whitepaper_Final.pdf](http://www3.dps.ny.gov/W/PSCWeb.nsf/96f0fec0b45a3c6485257688006a701a/c12c0a18f55877e785257e6f005d533e/$FILE/Staff_BCA_Whitepaper_Final.pdf)

³¹² 2015, <http://www.epri.com/abstracts/Pages/ProductAbstract.aspx?ProductId=000000003002004878>

³¹³ 2016, http://www.cpuc.ca.gov/uploadedFiles/CPUC_Public_Website/Content/About_Us/Organization/Divisions/Policy_and_Planning/Thought_Leaders_Events/Tierney%20White%20Paper%20-%20Value%20of%20DER%20to%20D%20-%2030-30-2016%20FINAL.pdf

ESM.3 Support the collaborative development of an integrated distribution plan

Action: Work with the PSC and Pepco to develop an integrated distribution plan designed to strategically and cost-effectively support the modernization of the grid to its envisioned future state. Integrate neighborhood-scale energy planning into broader real estate and economic development planning processes.

Relevance: Electricity systems require significant investments to maintain reliable and efficient energy delivery. As an example, Pepco is planning to invest about \$1.5 billion into its distribution infrastructure between 2016 and 2020.³¹⁴ These are investments into infrastructure that will last for decades into the future, and thus require careful planning and analysis to ensure that investments will serve the District's future needs. Without anticipating future integration with DER, these costly investments are at risk of becoming stranded assets.

To ensure investments in the grid are designed to support and accommodate grid modernization efforts, the District needs a formal planning process that accounts for high levels of DER integration. Integrated distribution planning (IDP) explicitly accounts for DER to help utilities and regulators make short- and medium-term investment decisions, understand where to dedicate resources, and identify outstanding issues that need additional evaluation or investigation.³¹⁵

In addition, as mentioned in the previous section (5.1) on Clean and Renewable Energy Supply, a system that can manage DER, like a microgrid, may enhance the grid's ability to integrate a large number of solar PV systems, storage, and sophisticated demand-side management assets, increasing the opportunity to realize the resiliency benefits of these energy assets. Therefore, a neighborhood-scale energy system should be considered and, if appropriate, planned for in areas that are targeted for a large number of solar PV systems and storage, as well as a large number of buildings with sophisticated demand-side management capabilities.

Details: Utilities traditionally engage in planning processes that focus on utility-owned infrastructure and assets, and are driven by financial needs and reliability obligations. This type of planning could be inadequate for a grid with a high penetration of DER.³¹⁶ By contrast, IDP involves the following:

- Explicit consideration of energy-efficiency and load-management programs, as well as neighborhood-scale energy systems, as alternatives to typical solutions using traditional generation resources.
- Consideration of environmental factors in addition to direct economic costs;
- Public participation.
- Analysis of the uncertainties and risks posed by different resource portfolios and by external factors.³¹⁷

As noted by the District Government, stakeholder comments on the FC1130 proceedings indicate that there may be an emerging consensus by a majority of stakeholders regarding the importance of a more holistic approach to distribution system planning.³¹⁸

³¹⁴ Formal Case 1139 – Application, Direct Testimony and Exhibits of Potomac Electric Power Company Witnesses Velazquez and McGowan https://edocket.dcpsec.org/apis/pdf_files/fa35334c-b414-42f2-85ed-61aa094e2e7d.pdf

³¹⁵ Integrated distribution planning (IDP) is also known as distributed resource planning (DRP).

³¹⁶ Comment on the Scope of the Proceeding by the District of Columbia Government (p.3), Formal Case 1130, District of Columbia Public Service Commission.

³¹⁷ Hirst and Goldman, 1991, Creating the Future: Integrated Resource Planning for Electric Utilities, Annu. Rev. Energy Environ. (p. 91)

³¹⁸ Supplementary Comment for the Third Information Session by the District of Columbia Government, Formal Case 1130, District of Columbia Public Service Commission

To succeed with IDP, the District Government needs a framework to guide the system planning process. Two states have recognized the need for IDP through legislation—California and Hawaii—while regulators and utilities are tackling IDP in other states.^{319,320} The District can learn lessons from other jurisdictions, while recognizing regulatory differences. As such, the District Government should work with the PSC, Pepco and other stakeholders to review the experiences in other jurisdictions to identify concepts and frameworks that may be useful for the District. To begin, the District can build on concepts outlined in grid modernization literature.³²¹

Possible IDP processes include:

- Running multiple multi-decade DER adoption scenarios with probabilistic engineering methods.
- Updating interconnection studies and procedures for DER based on revised planning methods and to accommodate an expanded volume of requests.
- Conducting a hosting capacity study to determine the distribution grid's ability to accommodate DER.
- Assessing the locational net value of adding DERs to different parts of the grid (may be positive or negative).
- Aligning transmission and distribution (T&D) planning and specifying the linkages between of activities to the District's demand forecasting and procurement proceedings.
- Identifying which capital projects are likely candidates for deferral or avoidance through the procurement of DER alternatives.³²²

Unlike jurisdictions like New York, California, and Hawaii, the District imports nearly all of its electricity. Therefore, the IDP process must also plan to increase the supply of renewable energy procured from outside the District. Given their recent growth and rapidly declining costs, the District should consider opportunities to procure more energy from utility-scale wind and solar generation, while considering the impact to the grid.

An effective IDP process should be aligned with and informed by several other recommended grid modernization actions, including the grid vision (ESM.1), DER benefit-cost framework (ESM.2), hosting capacity study (ESM.6), and energy mapping (ESM.7). IDP should then inform other recommended actions, including developing a list of no regrets actions (ESM.8), removing legislative and regulatory barriers (ESM.5), and pursuing pilot and demonstration projects (ESM.11). Actions identified in the District's *Climate Ready DC Plan* should also be considered in the development of the IDP process.

³¹⁹ California Public Utility Code §769 and regulation: <http://www.cpuc.ca.gov/PUC/energy/drp/>.

³²⁰ Hawaii Grid Modernization Law HB1943: http://www.capitol.hawaii.gov/session2014/bills/HB1943_CD1_.htm.

³²¹ e.g., De Martini and Kristov, 2015, Distributed Systems in a High Distributed Energy Resources Future: Planning, Market Design, Operation and Oversight; Electric Power Research Institute, 2015, The Integrated Grid: Realizing the Full Value of Central and Distributed Energy Resources

³²² Adapted from: De Martini and Kristov, 2015, Distributed Systems in a High Distributed Energy Resources Future: Planning, Market Design, Operation and Oversight; Developing the REV Market in New York: Department of Public Service Staff Straw Proposal on Track One Issues, Aug 22 2015, <http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId=%7bCA26764A-09C8-46BF-9CF6-F5215F63EF62%7d>.

Next Steps

- 1 After the development of the grid vision and DER benefit-cost framework (done by 2019), collaborate with the PSC and Pepco to develop a new electricity system planning framework based on IDP.
- 2 Continue to work with the PSC and Pepco to update the IDP with updates to the Plan.
- 3 Provide support and technical assistance to real estate developers and neighborhood organizations, enabling them to begin analysis of neighborhood-scale energy options.
- 4 Conduct a District-wide screening analysis for neighborhoods or areas that could most benefit from neighborhood-energy scale systems, and consider proposing zoning overlay districts for those areas to develop such systems that could provide public benefits.

ESM.4 Intervene in Public Service Commission proceedings related to grid modernization

Action: Intervene and participate in PSC proceedings related to grid modernization to ensure their coordination with other cases and filings that may affect or be affected by modernization efforts.

Relevance: Grid modernization efforts currently underway in the District have been primarily led by the PSC through FC1130 *Investigation into Modernizing the Energy Delivery Structure for Increased Sustainability*.³²³ The PSC process invites input from and collaboration with relevant stakeholders, and will continue to be a central actor in processes and decisions affecting grid modernization through its proceedings on formal cases and filings.

Details: As noted above, the District Government is already actively engaged in FC1130 and must remain engaged to ensure the District's long-term needs and objectives are adequately addressed. The specific formal case and filings relevant to the District's interests will be defined by the District's grid vision (Action ESM.1) and integrated distribution plan (Action ESM.3). Two recent examples in the District include FC1050 *Investigation of Implementation of Interconnection Standards in the District of Columbia* and FC1114 *Investigation of the policy, economic, legal and technical issues and questions related to establishing a dynamic pricing plan in the District of Columbia*.^{324,325} FC1050 will likely have implications for streamlining DER installations, while FC1114 may provide an opportunity to propose changes to rate structures that encourage greater demand management and energy efficiency.

In an effort to ensure broad stakeholder collaboration, the District should encourage attendance by trusted local organizations and tenant advocacy groups to ensure a well-rounded representation of tenant and property owners' interests.

³²³ http://www.dcpssc.org/PSCDC/media/PDFFiles/HotTopics/cdavis_1012015_1549_1_DOEE.pdf

³²⁴ FC1050 Investigation of Implementation of Interconnection Standards in the District of Columbia, https://edocket.dcpssc.org/apis/pdf_files/4c73a3b7-b05f-4aca-abaa-a9d67133e1d3.pdf

³²⁵ FC1114 Investigation of the policy, economic, legal and technical issues and questions related to establishing a dynamic pricing plan in the District of Columbia, https://edocket.dcpssc.org/apis/pdf_files/1ae3f346-75ed-4830-b550-57508be68b07.pdf

Next Steps

- 1 Continue to actively intervene in FC1130 and encourage participation by local organizations and tenant advocacy groups.
- 2 Identify, monitor and intervene in other current and future PSC proceedings pertinent to grid modernization efforts.

5.2.2.2 ANALYSIS OF THE ENERGY SYSTEM NEEDS AND CAPABILITIES

ESM.5 Outline a path to overcome legislative and regulatory barriers to grid modernization

Action: Investigate grid modernization actions in other leading regions. Outline the path the District will take to shift the current regulatory model to one capable of supporting a grid with the characteristics necessary to achieve the District's 2032 and 2050 climate and energy targets.

Relevance: Like the grid itself, jurisdictions' current legislative and regulatory frameworks were designed to function in a centralized electricity generation model. Utilities, customers, and other actors connected to the grid all make decisions that fit within the existing legislative and regulatory framework. Where that framework is misaligned with grid modernization needs, actors will make decisions that may run counter to those needed to support the grid modernization process. As such, the District Government must update its legislative and regulatory framework through multiple phases to properly guide actors' decision-making, as overall learning increases and the electricity system evolves through the modernization stages (see section 5.2.1.3).

Details: As noted in section 5.2.1.3, the development of a grid vision and the definition of grid modernization transition stages are both important actions to help the District Government develop an understanding of future grid needs, and to clarify the technologies, utility business models and incentives, and regulatory structures required to support them.

A next important step for the District Government will be to use this information to compare existing legislative and regulatory frameworks to the anticipated needs of the future grid. As with other actions in this section, looking to other jurisdictions further along in their grid modernization process will help to clarify what future legislative and regulatory framework may require. This process should be aligned with integrated distribution planning (Action ESM.3).

This process should result in two sets of legislative and regulatory changes: changes that can be pursued right away; and those that will require additional time or information to implement, such as additional analysis, pilot projects, or phased changes based on the scale of DER adoption and market readiness. For example, the District Government can begin by assessing and streamlining rules and procedures for interconnecting DER to the system, where barriers to DER implementation can easily arise.³²⁶ Once identified, the District Government should implement actions that support a movement into the next stage of the grid modernization process.

³²⁶ De Martini and Kristov, 2015, Distributed Systems in a High Distributed Energy Resources Future: Planning, Market Design, Operation and Oversight

An example of changes that may require additional analysis is the set of rules governing peer-to-peer energy transactions. These rules will be critical to move the electricity system to the third stage of grid modernization, and can provide significant opportunities to improve grid efficiency and reduce incidences of wasted energy in the medium-term. Realizing the benefits of these reforms will also require the concurrent development of a fair and efficient market with associated regulatory oversight, and will therefore require careful investigation and strategic planning to be executed successfully.

Next Steps

- 1 Following the development of the grid vision (done by 2019), develop an inventory of legislation and regulation that may affect grid modernization.
- 2 Identify legislation and regulations that present barriers to the District's progression through the stages of grid modernization, and collaborate with the PSC (and other agencies as necessary) to revise them.

ESM.6 Conduct a hosting capacity study of the District's distribution grid

Action: Conduct or commission a hosting capacity study to determine the level of DER integration that can be accommodated on different parts of the distribution grid without impacting the current grid infrastructure's ability to deliver high quality and reliable electricity.

Relevance: Different sections of the District's existing grid will be able to accommodate different levels of DER, and will consequently require different types of upgrade and investment. This detailed information on the grid's capacity will be necessary for the District to effectively move forward with grid modernization efforts and ultimately achieve its 2032 targets.

Details: Hosting capacity refers to the capacity of any given portion of the distribution system to accommodate additional DER given existing and already-planned facilities.³²⁷ A hosting capacity study of the District's distribution grid will provide critical information for integrated distribution planning (Action ESM.3), as well as any locational value assessments. In particular, study results will help the District identify and compare different opportunities to increase the capacity of existing feeder lines, either through targeted building energy use reduction actions, or the use of new DER technologies (e.g., smart inverters).

Study results will also help the District to prioritize grid modernization actions by identifying no regrets actions (Action ESM.8) and opportunities for pilot and demonstration projects (Action ESM.11). The results of a hosting study could also provide valuable information for the development of the solar proliferation strategy (Action CRE.5).

As grid modernization efforts proceed and evolve, hosting capacity studies triggered by certain thresholds of DER adoption can be conducted on a regular basis.

³²⁷ Electric Power Research Institute, 2015, The Integrated Grid: A Benefit-Cost Framework

- 1 Support Pepco to conduct a hosting capacity study in 2018, for completion in 2019.

ESM.7 Develop a location-based profile of energy use and GHG emissions

Action: Conduct a geospatial analysis of energy consumption, energy demand, PJM's locational marginal price, and GHG intensity based on grid location. Once complete, evaluate the usefulness of the tool and its potential improvements, and work to integrate it in regular, iterative analyses of the District's energy supply system.

Relevance: While the hosting capacity study recommended above reveals information on energy supply, an energy mapping exercise provides insights into energy demand. This provides valuable information on the current demand on the electricity system, and overall energy delivery system, as well as the potential future demand of a District more heavily reliant on electricity. This exercise supports both grid modernization efforts, as well as actions that target energy use and GHG emissions reductions directly.

Details: The District's existing building energy benchmarking data and advanced metering infrastructure provide a foundation upon which an energy map can be developed. Such a map can provide a geographic picture of energy consumption, energy price, energy demand, and GHG emissions in the District, providing valuable information for integrated distribution planning activities (see Action ESM.3), including decisions about peak demand reduction opportunities and infrastructure investments and deferrals. While the map may initially depend on both real data and simulations, accuracy will be improved with the use of real data and as such should be prioritized.

As with London's Heat Map, the primary purpose of this mapping exercise is to support the identification of neighborhoods where DER can be deployed to provide robust benefit to the distribution system.³²⁸ As the prevalence of DER increases, the energy map can be overlaid with the hosting capacity analysis (Action ESM.6). With this combined data, the District can simulate rates of DER adoption at the neighborhood scale to help identify priority targets for different types of investment, as well as potential candidate areas for pilot projects (see Action ESM.11).

In developing this energy map, the District Government should account for all types of energy – both electricity and other, fossil fuel based energy sources. Developing a geospatial understanding of natural gas demand (and building thermal demand in general) will assist in the identification of neighborhoods where thermal energy demand is high and where a neighborhood energy system may consequently be supported (see Action CRE.8). It will additionally help to identify areas of high natural gas use and by extension, where electricity growth can be anticipated as buildings shift from natural gas to electricity-based equipment for their thermal needs.

³²⁸ London Heat Map, <http://www.londonheatmap.org.uk/Content/HeatMap.aspx>

Next Steps

- 1 Undertake an initial mapping analysis in 2018 to support energy use reductions and DER increases.
- 2 Institute the mapping analysis as a regularly used tool through the implementation of the Plan and progression of the grid modernization process.

5.2.2.3 IMMEDIATE “NO-REGRETS” ACTIONS

ESM.8 Generate, evaluate, and prioritize a list of actions that the can be taken immediately

Action: Identify the infrastructural, organizational, operational, financial, regulatory, and technological features and components that appear to be absolutely necessary for realizing the grid vision. Prioritize these actions for immediate and short-term implementation.

Relevance: While the specific characteristics of a modernized grid will continue to emerge, jurisdictions further along in the grid modernization process have indicated a set of key features that are consistent across future scenarios. These characteristics should be the focal points for immediate planning, action, and investment.

Details: The pace and scope of change required for grid modernization can be a decade-long process. However, both DER demand and the need for energy use and GHG reductions increases and accelerates each year. To keep pace with these changes, the District must begin to act immediately, even while planning its grid modernization process. “No-regrets” actions represent key opportunities for the District Government to make swift progress toward its 2032 targets.

A first step is to generate a list of the infrastructural, organizational, operational, financial, regulatory, and technological features and components that appear to be consistent and necessary to modernizing the grid. From this list, a subset of near-term no regrets actions that can be taken immediately should be prioritized for investment. “No-regrets” actions are those initiatives that both improve the state of a conventional energy delivery system or support the shift to a modernized energy delivery system, and can help key stakeholders gain important experience around key aspects of grid modernization.³²⁹ They may address aspects of grid infrastructure, DER technologies, operational changes, regulatory structures, or any other aspect of the energy delivery system.

Though the precise nature of these actions will depend on the District’s particular context, analysts have identified a list of potential “no-regrets” actions:

- Advanced field telecommunications networks.
- Increased grid operational visibility.
- Fast and flexible bulk electric storage to balance power fluctuations and mismatches resulting from non-dispatchable generation.

³²⁹ Developing the REV Market in New York: Department of Public Service Staff Straw Proposal on Track One Issues, Aug 22 2015, <http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId=%7bCA26764A-09C8-46BF-9CF6-F5215F63EF62%7d>

- Aggregated advanced meter data at the feeder level to enhance energy services.
- Smart inverters that enable DER to provide voltage and frequency support and to communicate with energy management systems.
- Tools that increase customer knowledge of their electricity use and how to better manage it.
- Building codes that facilitate the integration of DER with a focus on long-term grid capabilities needed to achieve the grid vision (see Action 0).
- Tools to provide electronic sensing and automated data extraction.
- Adjustable electronics that allow dynamic control of grid power flows.
- Utility and regulatory procedures that expedite the evaluation and integration of DER.
- Legislation allowing third-party access to grid data, while considering grid security.^{330,331,332}

The District Government should align this action with the development of integrated resource plans (Action ESM.3) and utilize the newly developed benefit-cost framework for DER (Action ESM.2).

Next Steps

- 1 After the development of the grid vision and the characterization of the District's grid modernization stages, conduct additional research on commonalities in grid modernization activities across leading jurisdictions.
- 2 Generate a list of no regrets actions that the District Government can implement immediately, including in collaboration with the PSC and Pepco.

³³⁰ More Than Smart: A Framework to Make the Distribution Grid More Open, Efficient and Resilient (pp3-4,11), 2014, Greentech Leadership Group, <http://morethansmart.org/wp-content/uploads/2015/06/More-Than-Smart-Report-by-GTLG-and-Caltech-08.11.14.pdf>

³³¹ Electric Power Research Institute, 2015, The Integrated Grid: Realizing the Full Value of Central and Distributed Energy Resources

³³² Testimony of Dr. Jeffrey Taft, Chief Architect for Electric Grid Transformation, Pacific Northwest National Laboratory before the U.S. Senate Committee on Energy and Natural Resources, March 17, 2015.

ESM.9 Leverage existing advanced metering infrastructure data

Action: Identify and pursue opportunities to utilize the data collected by advanced metering infrastructure already installed across the District.

Relevance: In partnership with Pepco, the District Government undertook a *Smart Grid Project* that included the deployment of advanced metering infrastructure (AMI) throughout the District.³³³ Pepco has now exchanged over 99% (>296,000) of the District's traditional meters with smart meters.³³⁴ This deployment of AMI offers the District a strong foundation on which to strategically modernize the grid, plan for DER deployment, and improve grid resilience.

Details: While the District is one of only a few jurisdictions in the U.S. with an extensive AMI network, it has not yet begun to take advantage of the full functionality of this infrastructure. For example, smart meters collect and transmit detailed real-time customer use, which can be used by both customers and regulators to reduce peak demand. However, this data is not yet available. Customers can get the data on a next-day basis via Green Button's Connect My Data Application Program Interface, but this historical interval data is not nearly as useful as true real-time data. The AMI meters have the capability to transmit real time data to customers via the ZigBee network; however, Pepco has not turned this function on.

By making this data available to the District and other potential stakeholders, a greater understanding of energy use in different development contexts in the District can be achieved. Interval meter data is useful to the District, consumers, Demand-Side Management program operators, and potential microgrid providers. It can support the District and its stakeholders in achieving energy use reductions, peak load reductions, GHG reductions, DER installations, and the overall grid modernizing process.

Next Steps

- 1 Work with Pepco and the PSC to develop a timeline to realize the full potential of AMI in the District.
- 2 If needed, develop one or more pilot programs to test the potential of improved access to information before taking this initiative further.

³³³ Pepco-District of Columbia: Smart Grid Project, <https://www.smartgrid.gov/files/Pepco-District-Columbia-Smart-Grid-Project-2015.pdf>

³³⁴ DC PSC Electric Grid Upgrades, <https://dcpsc.org/Newsroom/HotTopics/Grid-Modernization/Realizing-The-Full-Potential-of-Advanced-Metering.aspx>

ESM.10 Identify near-term projects that should be coordinated with grid modernization activities

Action: Develop an inventory of large-scale development projects and government regulatory procedures scheduled to occur within the next five years that may affect or be affected by grid modernization. Take steps to align grid modernization efforts with these actions.

Relevance: The District Government and its stakeholders are implementing many actions beyond grid modernization, some of which may offer mutually beneficial opportunities through project alignment. Coordinating grid modernization efforts with such actions can lower costs, accelerate the grid modernization process, and ultimately support the District achieve its 2032 climate and energy targets.

Details: Actions planned or currently underway offer opportunities to share upfront investment costs, reduce transaction costs (e.g., labor and management), accelerate implementation, and support pilot projects. The most obvious examples are larger-scale infrastructure and construction projects. However, aligning with less tangible actions such as building and energy code updates (see Action NC.1) or ongoing regulatory procedures (Action ESM.4) will also help to ensure that District Government actions will cost-effectively and reliably support a modernized grid.

As such, the District Government should develop an inventory of relevant projects and proceedings that are either currently ongoing or expected to occur over the next five years, and seek opportunities for alignment. This process should be repeated as grid modernization efforts continue to ensure that staff members focused on grid modernization are made aware of any new projects and proceedings.

This action should also be aligned with the actions presented in the *Climate Ready DC Plan*, which will require significant upgrades to critical infrastructure (e.g., electricity substations, hospitals).

Next Steps

- 1 In 2018, assemble an inventory of ongoing projects that may affect or be affected by grid modernization and institute a regular process whereby such projects can be identified.

5.2.2.4 PROOF OF CONCEPT PROJECTS

ESM.11 Pursue pilot projects related to key modernization capabilities and technologies

Action: Identify and prioritize key capabilities and technologies that are critical to successful grid modernization but that would benefit from learning generated through a real-world test application. Develop and implement plans to undertake pilot projects, with an objective to start in LMI communities.

Relevance: As outlined in section 5.2.1.3, grid modernization requires a phased transition through three stages to a future state that is currently only loosely defined. To clarify that future state, pilot projects can be used to test and evaluate grid modernization actions with uncertain impacts to better understand both their impact and value.

Details: Grid modernization requires coordinated long-term action supported by multiple stakeholders. The inherent uncertainty of the outcome of such a broad process can be reduced using research or analysis (as in several of the actions discussed above), or by conducting and evaluating real-world tests. An example of such program is California's Demand Response Auction Mechanism (DRAM) pilot program, initiated in 2015. The purpose of the DRAM program is to establish demand response as a market-based and highly responsive electricity resource. Through DRAM, California is working to establish a market-based auction, auction protocols, a standard contract, evaluation criteria, and non-binding cost estimates. In doing so, California will encourage third-parties to bid demand response resources into wholesale markets, similar to how generators bid into markets, by making the process easier, more consistent, and less risky.³³⁵

Other examples of pilot projects can be found in Australia, which will place select neighborhoods on microgrids powered entirely by solar and storage.^{336,337} These kinds of projects are important tests of the viability of a zero GHG grid model, while providing valuable lessons for the utilities and regulators involved. Applied in the District, such pilot projects can help the District Government to understand the potential value of certain technologies (e.g., energy storage) and grid configurations (e.g., microgrids), as well as key modernization concepts. They help to clarify both the modernization process, as well as the final end state.

Pilot projects on a range of technologies and grid modernization concepts should be considered, including:

- Aggregated solar plus battery storage microgrids
- Demand side management as virtual power plant
- Automated distribution communication and sensing
- Conservation voltage regulation
- Smart inverters
- Fault location and isolation and service restoration
- Microgrids for critical infrastructure

³³⁵ California Public Utilities Commission, 2015 Annual Report, http://www.cpuc.ca.gov/uploadedFiles/CPUC_Public_Website/Content/About_Us/Annual_Reports/2015%20CPUC%20Performance%20and%20Accountability%20Annual%20Report_v004.pdf

³³⁶ Utility to take part of Melbourne suburb off-grid with solar + storage, Apr 18 2016, Reneweconomy, <http://reneweconomy.com.au/2016/utility-to-take-part-of-melbourne-suburb-off-grid-with-solar-storage-94822>

³³⁷ South Australia Launches Largest Trial Of Rooftop Solar & Energy Storage, May 19 2016, CleanTechnica <http://cleantechnica.com/2016/05/19/south-australia-launches-biggest-trial-rooftop-solar-energy-storage/>

- Zero GHG emergency or backup generation
- Batteries and other energy storage and backup generation as peak shaving resources
- Peer-to-peer energy transaction models

The District should pursue such pilot projects in coordination with stakeholders where appropriate, and ensure the broad communication and dissemination of lessons learned. Furthermore, the District should seek opportunities for pilot projects in LMI communities. Successful pilot projects are likely to yield benefits including improved efficiency and greater resilience to system outages. Improved efficiency would help reduce energy costs for LMI communities that can already have difficulty paying energy costs, and are more likely to be at risk in the case of, for example, a prolonged outage, so would benefit from the increased resilience.

A pilot project opportunity in the short-term already exists at Mt. Vernon Square, where Pepco has identified a need to install a new \$298.4 million substation as early as 2020 to address anticipated network overloads and to serve an increased load associated with new mixed-used developments.³³⁸ In lieu of the investment in the substation, the District could work with Pepco to design and implement a pilot project focused on demonstrating the ability of demand management-focused DER to defer traditional grid infrastructure investments. Such a project draws on the experiences of California-based Pacific Gas & Electric, which estimated that a \$192 million investment into transmission improvements could be avoided due to the growth in DER, energy efficiency, and demand response.³³⁹ Applying this principle in the District would demonstrate the potential of grid modernization to both avoid future investment costs and reduce GHG emissions.

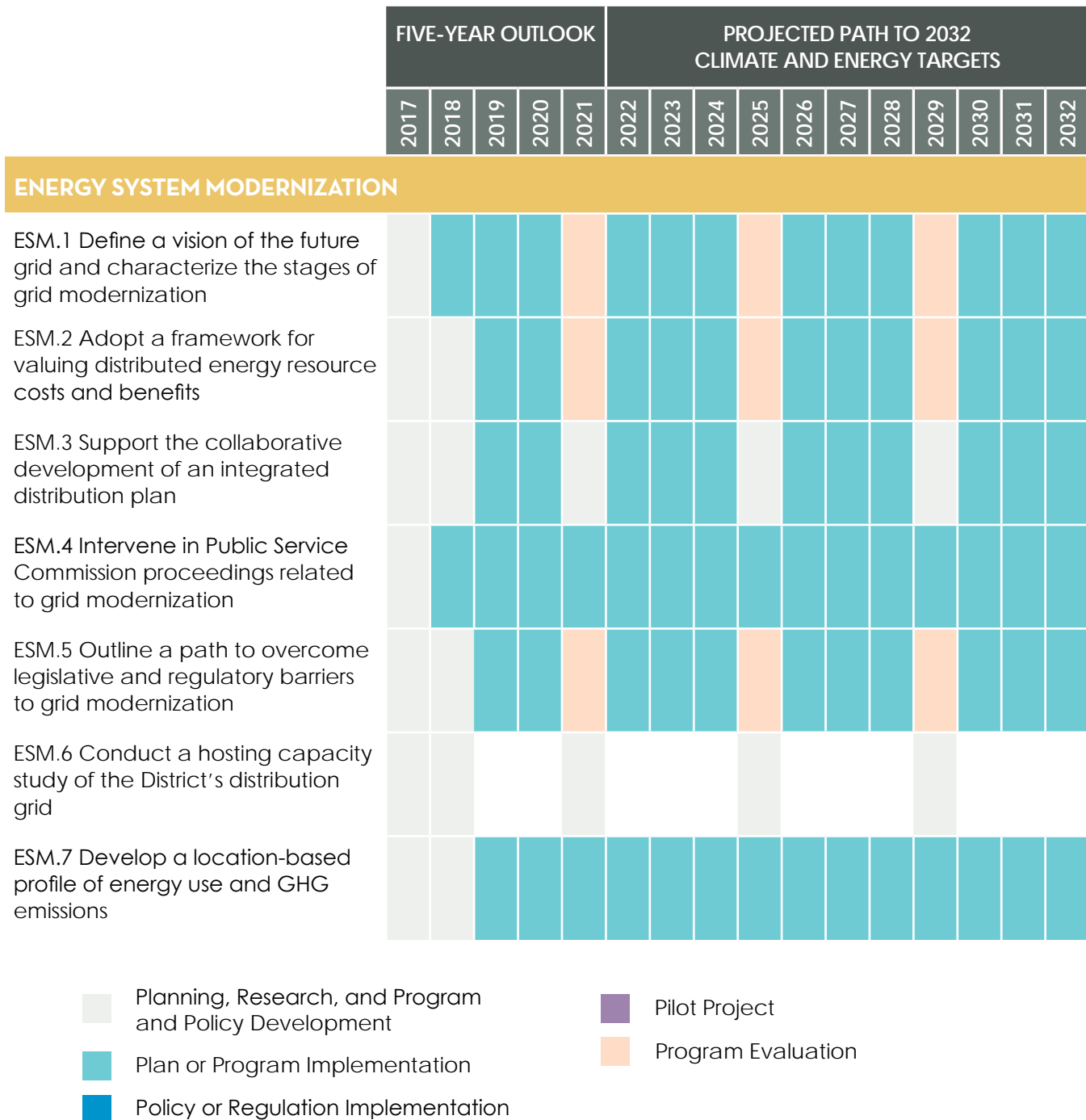
Next Steps

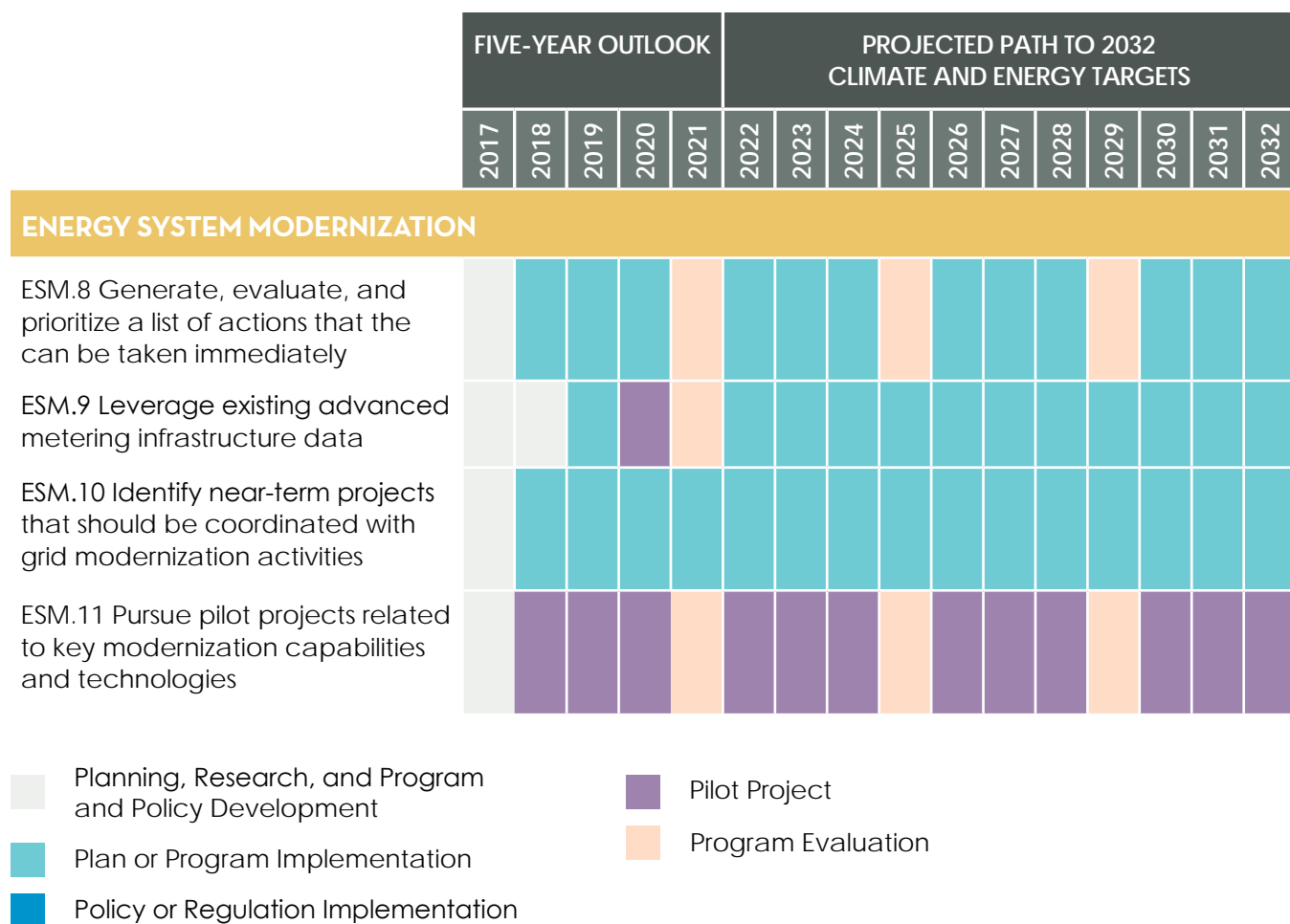
- 1 Pursue the development of a pilot project at Mt. Vernon Square.
- 2 Using the results of other grid modernization actions, identify and pursue pilot projects that will help the District and its stakeholders understand the process and potential outcome of grid modernization.

³³⁸ Supplementary Comment for the Third Information Session by the District of Columbia Government, Formal Case 1130, District of Columbia Public Service Commission

³³⁹ Californians Just Saved \$192 Million Thanks to Efficiency and Rooftop Solar, May 31 2016, Greentech Media, <http://www.greentechmedia.com/articles/read/Californians-Just-Saved-192-Million-Thanks-to-Efficiency-and-Rooftop-Solar>

5.2.3 ENERGY SYSTEM MODERNIZATION ROADMAP







TRANSPORTATION

6 TRANSPORTATION

This chapter outlines the actions necessary to reduce the greenhouse gas (GHG) emissions that result from the District's passenger vehicles. It does not include actions to shift the District's mode share (e.g., from driving to cycling), nor does it refer to actions to reduce GHG emissions from fleet vehicles. This omission is deliberate and intended to ensure that the chapter does not duplicate other research, planning, and policy efforts, including the District's Multimodal Long-Range Transportation Plan *moveDC* and the *Sustainable DC Plan*. The *moveDC Plan* provides long- and short-term recommendations to achieve several transportation-related objectives, including the installation of public electric vehicle chargers.³⁴⁰

The actions recommended below align with those in the *Sustainable DC Plan*, the *moveDC Plan*, and other District plans, particularly those focused on achieving the 2032 mode share target established in the Sustainable DC Plan: 50% of commuter trips from public transit, 25% from biking and walking, and 25% by car or taxi.³⁴¹ The impact of the actions described below have been calculated based on the assumption that the District will achieve this mode share target, thus contributing to the total emissions reductions needed to achieve the 2032 target. Based on the model, achieving the mode share target would be one of the most effective ways for the District to reduce GHG emissions by 2032. The set of transportation-focused actions is summarized in a roadmap at the end of the chapter.

As the District Government begins prioritizing the recommended actions, designing the specific policies and programs, and developing implementation plans in collaboration with stakeholders, it should align Clean Energy DC with ongoing and existing work, and augment it with other transportation actions that emerge.

³⁴⁰ *moveDC*, <http://www.wemovedc.org>

³⁴¹ Sustainable DC Plan, p.12

6.1 ELECTRIC VEHICLE READINESS AND ADOPTION

6.1.1 REDUCING GHG EMISSIONS FROM TRANSPORTATION

Transportation sector emissions are significantly lower in the District than those that originate from the built environment. This is a result of the District's high density land use and abundance of transit options. Vehicle miles traveled (VMT) per capita have decreased considerably between 2000 and 2010, in part attributable to a decrease in the number of District residents who travel by private vehicle from 49.4% to 40.7%.³⁴² During this same period, gasoline and diesel used in vehicles made up only 12% of the District's energy use, with use steadily declining as federal standards improved vehicle fuel efficiencies and transit ridership increased, due in part to high gasoline prices.³⁴³ However, vehicles produce approximately 21% of the District's annual GHG emissions, making the transportation sector an important target in its efforts to achieve the District's target of carbon neutrality by 2050.³⁴⁴ This section focuses on recommended actions designed to shift the existing passenger vehicle stock (e.g., cars and trucks owned by individuals) from one dependent on fossil fuels, to one made up entirely of low-carbon and eventually zero-emission passenger vehicles.

6.1.1.1 THE NEED FOR ZERO EMISSION VEHICLES

While increases in fuel efficiency and shifts to transit and other lower emission transportation options will continue to reduce transportation GHG emissions, passenger vehicles still form a substantial part of personal mobility. Research has indicated that achieving carbon neutrality by 2050 will require passenger vehicle fleets to consist entirely, or nearly entirely of vehicles that emit no GHG emissions.³⁴⁵ As vehicles typically remain in use for an average of 11.5 years or longer, shifting passenger vehicle fleets to new no-carbon technology will require a longer-term process.³⁴⁶ Furthermore, zero-emission alternatives are just beginning to emerge for heavy freight uses (e.g., airline, rail, etc.). This means that if the transportation sector is to support the District becoming carbon neutral by 2050, future work will require an additional focus on heavy freight.

Zero emission vehicles are defined as those that emit zero pollutants (GHG or otherwise) during their operation, including emissions that result from fuel production. Zero emission vehicles can be powered by a range of energy sources such as electricity, hydrogen, or ethanol; however, electric vehicles have enjoyed the most success in terms of market uptake and adoption.³⁴⁷ Compared to hydrogen vehicles, electric vehicles are more advanced in their technological development, come in a wider variety of models, and can be charged at home and work, making them more attractive and less reliant on public charging or refueling infrastructure. Low- and zero-carbon electricity production is also more established and cheaper than hydrogen production, and has an established transmission and distribution network.

³⁴² This does not include people who commute from outside the District. moveDC – Multimodal Long-Range Transportation Plan, 2014, p.5. Note, however, that the VMT calculations in the *Clean Energy DC* model includes VMT for all vehicles driven in the District, regardless of origin or destination.

³⁴³ 2014 Comprehensive Energy Plan for the District of Columbia (unreleased), pp.4, 24.

³⁴⁴ 2011 District of Columbia Greenhouse Gas Emissions Inventory, <http://doee.DC.gov/sites/default/files/dc/sites/ddoe/publication/attachments/GHGInventory-1205-.pdf>.

³⁴⁵ E.g., Williams et al. (2012). The technology path to deep greenhouse gas emissions cuts by 2050: the pivotal role of electricity. *Science*, 335(6064), 53–9; Kyle, P., Kim, S.H., 2011. Long-term implications of alternative light-duty vehicle technologies for global greenhouse gas emissions and primary energy demands. *Energy Policy* 39, 3012–3024. doi:10.1016/j.enpol.2011.03.016; National Research Council, 2013. *Transitions to Alternative Vehicles and Fuels*. The National Academies Press, Washington, DC; California Air Resources Board, 2009, Attachment B - 2050 Greenhouse Gas Emissions Analysis: Staff Modeling in Support of the Zero Emission Vehicle Regulation.

³⁴⁶ Average Age of Light Vehicles in the U.S. Rises Slightly in 2015 to 11.5 years, IHS Reports, <http://press.ihs.com/press-release/automotive/average-age-light-vehicles-us-rises-slightly-2015-115-years-ihs-reports>

³⁴⁷ International Energy Agency, 2016, Tracking Clean Energy Progress 2016, <http://www.iea.org/publications/freepublications/publication/TrackingCleanEnergyProgress2016.pdf>

Meanwhile, zero-emission ethanol vehicles depend on the development of cost-effective cellulosic ethanol production—which has thus far proved elusive—and a stable supply of feedstock, which has been controversial in the United States due to perceived competition with food production. Thus, while hydrogen and ethanol vehicles may have a long-term role to play in a low- or zero-carbon passenger vehicle future, they are a lower priority for local and state governments than electric vehicles.

Recommendations in this section therefore focus on policies and programs that can support a transition to electric vehicles (EV). These include battery electric vehicles powered entirely by electricity from the grid, as well as plug-in hybrid electric vehicles powered by electricity from the grid and supplemented by a gasoline or diesel engine to provide a longer driving range. In some states, plug-in hybrid electric vehicles are considered a transitional vehicle on the pathway to a 100% zero-emission passenger vehicle fleet.³⁴⁸

To increase EV adoption, the District Government must remove or overcome barriers that limit consumer interest and willingness to purchase them. These barriers are rooted in both technological characteristics and consumer preferences that have made EVs more expensive and less attractive than conventional vehicles. In addition to higher prices, consumers also have concerns over EV range, availability of public charging infrastructure, risks associated with a new technology, adequate choice in available models and categories, and overall reliability.³⁴⁹ Some of these barriers can be addressed directly by the District Government; for example, through the provision of charging infrastructure. Others depend on action by automakers, such as the continued expansion of EV driving range, or senior governments, which can introduce policies that increase EV supply and model availability.

In addition, vehicles operated by independent ride-hailing drivers and managed by transportation network companies (TNCs) represent a significant subgroup of private vehicles transitioning to EVs in the near future. TNCs have signaled their intentions to transition their independent driver networks to driverless fleets as soon as possible, expressed through their autonomous vehicle (AV) research and development partnerships with vehicle manufacturers.^{350,351,352} TNC services have been linked to decreases in public transit ridership, a mode shift with higher emissions impacts, as ridehailing services require more VMT and vehicle space on the road to serve the same numbers of passengers.³⁵³ However, in the future, AV partnerships between TNCs and vehicle manufacturers have the potential to shift the private automobile market from an ownership model to a shared or subscription-based model.³⁵⁴ The District Government has already adopted policy allowing for the operation of AVs on public roads.³⁵⁵ As AV technologies advance, the District Government can foster benefits by enacting policies supportive of a shared ownership model. As shown in 8, the potential for systemic efficiencies is greater with the shared use of mobility assets.

348 California Air Resources Board, 2009.

349 Sierzchula, W., Bakker, S., Maat, K., van Wee, B., 2014. The influence of financial incentives and other socio-economic factors on electric vehicle adoption. *Energy Policy* 68, 183–194. doi:10.1016/j.enpol.2014.01.043

350 Isaac, Mike, "Uber Strikes Deal With Volvo to Bring Self-Driving Cars to Its Network," *The New York Times*, November 20, 2017. <https://www.nytimes.com/2017/11/20/technology/uber-deal-volvo-self-driving-cars.html>.

351 Kokalitcheva, Kia, "GM and Lyft Will Test Self-Driving Taxis Within the Next Year," *Fortune*, May 5, 2016. <http://fortune.com/2016/05/05/lyft-gm-self-driving-pilot/>

352 Isaac, Mike, "Lyft Adds Ford to Its List of Self-Driving Car Partners," *The New York Times*, September 27, 2017. <https://www.nytimes.com/2017/09/27/technology/lyft-ford-self-driving-cars.html>

353 Clewlow, Regina R., and Gouri Shankar Mishra, "Disruptive Transportation: The Adoption, Utilization, and Impacts of Ride-Hailing in the United States," University of California, Davis, Research Report UCD-ITS-RR-17-07. http://usa.streetsblog.org/wp-content/uploads/sites/5/2017/10/2017_UCD-ITS-RR-17-07.pdf

354 Higgins, Tim, "The End of Car Ownership," *The Wall Street Journal*, June 20, 2017. <https://www.wsj.com/articles/the-end-of-car-ownership-1498011001>

355 Code of the District of Columbia. Chapter 23A. Autonomous Vehicles. <https://beta.code.dccouncil.us/dc/council/code/titles/50/chapters/23A/>

Benefit	Individual Ownership	Shared Ownership
Traffic safety	Yes	Yes
Time for productivity or leisure	Yes	Yes
Expanded mobility for those unable to drive	Possibly	Possibly
Fluidity of traffic flow	Possibly	Enhanced
Reduced emissions	Possibly	Enhanced
Reduced vehicle congestion	Possibly	Enhanced
Increased availability of land	Possibly	Enhanced

↑ **Table 7.** Shared Ownership of Autonomous Vehicles Can Lead to the Most Benefits ³⁵⁶

Aside from shared-ownership EVs, public transit bus fleets represent unique opportunities with respect to zero emission vehicles. They represent both a significant portion of the District's emissions output and are directly controlled by public agencies. As of 2015, 20% of the District metro region is commuting by transit.³⁵⁷ In that same year, WMATA and DDOT bus operations accounted for approximately 160,000 metric tons of the GHG emissions (carbon dioxide equivalent).³⁵⁸ In 2017, both WMATA and DDOT welcomed all-electric buses into their fleets for the first time. This is a significant milestone, but the cost for an average 40-foot low-floor all-electric bus is still at least 60-70% higher than the comparable diesel bus, making conversion to a zero emission fleet a challenging endeavor.

6.1.1.2 THE DISTRICT'S PASSENGER VEHICLE MARKET CONTEXT

Like all jurisdictions, the scale of EV adoption in the District depends significantly on the extent to which automakers produce and sell affordable EVs that are attractive to most consumers. However, the District has some unique characteristics that will require novel approaches to increasing EVs. From a geographical perspective, the District covers a small, dense land area that makes public transit, cycling, and walking more accessible and attractive to citizens. As a result, 37% of households do not own a vehicle—a number that is approximately twice the national average.³⁵⁹ However, the District's geography and economy also bring approximately 400,000 commuters into the District every workday (equivalent to 60% of the District's population), with the majority reliant on personal vehicles.^{360,361} Furthermore, the District contains no new vehicle dealerships, except for a Tesla store, meaning purchase incentives currently have limited value. The District's geography and land use patterns make this number unlikely to change.³⁶²

³⁵⁶ Fields, David, and Terra Curtis, "Driverless Vehicles and Your Community," APA Planning, December, 2016. <http://nelsonnygaard.com/wp-content/uploads/2016/12/Planning-AV-2016.pdf>

³⁵⁷ Washington Metropolitan Area Transit Authority, "Metro Sustainability 2017." <https://www.wmata.com/initiatives/sustainability/upload/2017-Annual-Sustainability-Report.pdf>

³⁵⁸ It is important to evaluate this gross sum of emissions within the context of the respective service levels provided by WMATA and DDOT. While a heavy-duty diesel transit bus produces more emissions per mile than the average private motor vehicle, transit has the capacity to move more people per vehicle mile and with less area of public right-of-way per passenger trip than the average private motor vehicle.

³⁵⁹ National Capital Region Transportation Planning Board (NC RTPB)

³⁶⁰ Commuter figures from NC RTPB.

³⁶¹ Personal vehicle reliance information from 2014 Comprehensive Energy Plan for the District of Columbia (unreleased), p.180.

³⁶² Discussion with DOE staff, March 18, 2016.

As such, the District is highly dependent on actions taken by neighboring states (Maryland and Virginia), and is tasked with identifying novel approaches to convince both District residents and commuters to choose EVs rather than conventional petroleum-fueled vehicles. As a member of the *Transportation & Climate Initiative of the Northeast and Mid-Atlantic States*, and a member jurisdiction of the Metropolitan Washington Council of Governments, the District Government has two valuable forums in which to coordinate actions and approaches with neighboring states.^{363,364}

6.1.1.3 CURRENT DISTRICT GOVERNMENT ACTIONS

Several actions have already been taken. As of 2015, the District had more policies and programs supporting EVs than any other city outside California (tied with Portland).³⁶⁵ However, the District has a lower-than-average EV market share when compared to the other 24 most populous cities in the U.S (0.75% of new vehicles registered in the District in 2014).³⁶⁶ Current actions include:

- An exemption for vehicle title fees (available to any vehicle with a fuel economy over 40 mpg).³⁶⁷
- A tax incentive to convert petroleum-fueled vehicles to electricity (and other qualifying alternative fuels).³⁶⁸
- Exemptions from high occupancy vehicle lane restrictions and any time-of-day and day-of-week driving restrictions.³⁶⁹
- Tax incentives for residential and public charging infrastructure.³⁷⁰

In 2012, GTM Research ranked the District the tenth most “EV-ready” city in the country, with approximately 4.7 public charging stations for every 100,000 residents.³⁷¹ Furthermore, EV charger incentives are available until December 31, 2026—indicative of the District’s commitment to facilitating a long-term shift to EVs.

The District Government is also at the forefront of actions regulating the operation of AVs on local public roads. An early adopter of AV policies in 2012, it is now joined by 21 states who have enacted AV legislation since 2011.³⁷² The District Government has taken the following actions related to AVs and a shared ownership model:

- The *Autonomous Vehicle Act of 2012* officially permitted the operation of AVs on public roads, provided that the vehicles, among other requirements, can comply with local traffic and motor vehicle laws, as well as traffic control devices.³⁷³

³⁶³ Transportation & Climate Initiative - Northeast Electric Vehicle Network in Action, <http://www.transportationandclimate.org/northeast-electric-vehicle-network-action>

³⁶⁴ Metropolitan Washington Council of Governments, Electric Vehicle Planning Initiative – Documents, http://www.mwccog.org/committee/committee/documents.asp?COMMITTEE_ID=272

³⁶⁵ Lutsey, N., Searle, S., Chambliss, S., Bandivadekar, A., 2015, Assessment of leading electric vehicle promotion activities in United States cities. Washington DC, USA.

³⁶⁶ Lutsey, 2015, ICCT White Paper – Transition to a Global Zero-Emission Vehicle Fleet: A Collaborative Agenda for Governments; Jin et al., Oct 2014, ICCT White Paper – Evaluation of State-Level U.S. Electric Vehicle Incentives.

³⁶⁷ DMV (2016) Green Driver State Incentives in Washington DC, <https://www.dmv.org/washington-dc/green-driver-state-incentives.php>

³⁶⁸ Up to a maximum of \$19,000. Applies to other qualified alternative fuels as well. National Conference of State Legislatures, 2015, State Efforts Promote Hybrid and Electric Vehicles, <http://www.ncsl.org/research/energy/state-electric-vehicle-incentives-state-chart.aspx>

³⁶⁹ DMV (2016) Green Driver State Incentives in Washington DC

³⁷⁰ GoElectricDrive Incentive Locator – District of Columbia, <https://www.goelectricdrive.org/you-buy/incentives>

³⁷¹ GTM Research, 2012, Top 10 EV-Ready Cities, <http://www.greentechmedia.com/articles/read/Top-10-EV-Ready-Cities>

³⁷² National Conference of State Legislatures, “Autonomous Vehicles | Self-Driving Vehicles Enacted Legislation,” October 23, 2017, <http://www.ncsl.org/research/transportation/autonomous-vehicles-self-driving-vehicles-enacted-legislation.aspx>

³⁷³ Stone, Sean, “State Laws on Autonomous Vehicles,” The Council of State Governments, September 15, 2016, <http://knowledgecenter.csg.org/kc/content/state-laws-autonomous-vehicles#11>

- The District joined the Bloomberg Philanthropies and Aspen Institute Global Initiative on Autonomous Vehicles, selected as one of the first ten cities worldwide to join a multi-city cohort group leading the way on autonomous technology preparedness.³⁷⁴
- The District Government convened an interagency working group to prepare DC for the opportunities and challenges posed by the introduction of autonomous vehicle technology.
- The District partnered with Starship Technologies to pilot food delivery robots on sidewalks in a pilot area in central DC, the first US-based delivery bot pilot program for this technology.³⁷⁵
- In 2016, the District Government approved changes to its zoning code to provide exemptions to minimum parking requirements in select locations.^{376,377}
- In October 2017, DDOT launched its “nightlife parking demonstration,” on Connecticut Avenue, between Rhode Island and Dupont Circle; a yearlong pilot program converting 60 on-street parking spaces to designated pick-up/drop-off zones for use by transit, taxis, and TNCs, between 10:00 p.m. and 7:00 a.m. on Thursdays, Fridays, and Saturdays.^{378,379}

In addition, transit service providers in the District have taken steps to reduce their vehicles’ emissions footprints. WMATA and DDOT have already taken up the following actions to improve the emissions footprint of their transit services:

- Both agencies operate bus fleets featuring a mix of propulsion technologies, beyond traditional diesel propulsion, including clean diesel buses, hybrid diesel-electric buses, compressed natural gas buses, and full electric buses.³⁸⁰
- In 2017, both WMATA and DDOT debuted their first all-electric transit fleet vehicles.
- DDOT adopted its sustainability plan in 2010, defining eight priority areas to implement mores sustainable practices in its operations.³⁸¹
- WMATA adopted its Sustainability Initiative in 2014, setting 10 performance targets to pursue and achieve by 2025.³⁸² This initiative has influenced new sustainable capital procurements, improved efficiencies in service and maintenance operations, and its progress is documented in WMATA’s annual sustainability report.³⁸³
- One of WMATA’s sustainability targets is to reduce GHG emissions per vehicle mile by 50% by 2025.

It should be noted that actions recommended below target a critical aspect of reducing vehicle GHG emissions—transitioning from petroleum-fueled vehicles to zero-emission vehicles—but do not cover the range of actions required to reduce both GHG emissions and energy use

374 Bloomberg Philanthropies, “Five More Cities Join Bloomberg Philanthropies And The Aspen Institute’s Global Initiative On Autonomous Vehicles,” January 9, 2017. <https://www.prnewswire.com/news-releases/five-more-cities-join-bloomberg-philanthropies-and-the-aspen-institutes-global-initiative-on-autonomous-vehicles-300387730.html>

375 Mayes, Liz Ellis, “DC will be the first US city to pilot food delivery bots,” Technical.ly DC, January 6, 2017. <https://technical.ly/dc/2017/01/06/food-delivery-bots-starship/>

376 Office of Zoning, “Zoning Handbook: Vehicle Parking,” District of Columbia, accessed November 21, 2017. <http://handbook.dcoz.dc.gov/zoning-rules/general-rules/parking/vehicle-parking/>

377 64 DCR 6110 (June 30, 2017). <https://dcregs.dc.gov/Common/DCMR/RuleDetail.aspx?RuleId=21298>

378 Owens, Terry, and Michelle Phipps-Evans, “DDOT to Launch a Nightlife Parking Demonstration,” District Department of Transportation, October 3, 2017. <https://ddot.dc.gov/release/ddot-launch-nightlife-parking-demonstration>

379 Schneider, Benjamin, “D.C. Gives Uber and Lyft a Better Spot in Nightlife,” CityLab, October 25, 2017. <https://www.citylab.com/transportation/2017/10/a-dc-neighborhood-rethinks-parking/543870/>

380 Clean diesel buses are diesel-powered buses outfitted with emission-reducing components, such as diesel particulate filters and select catalytic reduction systems. The EPA has a list of verified clean diesel technologies that can help a diesel engine meet the EPA’s clean diesel standards. Sources: (1) Centers for Disease Control and Prevention, “Clean Diesel Bus Fleets,” August 5, 2016. <https://www.cdc.gov/policy/hst/his5/cleandiesel/index.html>. (2) U.S. Environmental Protection Agency, “Verified Technologies List for Clean Diesel,” updated May 22, 2017. <https://www.epa.gov/verified-diesel-tech/verified-technologies-list-clean-diesel>

381 District Department of Transportation, “Sustainability Plan,” October 2010. https://ddot.dc.gov/sites/default/files/dc/sites/ddot/publication/attachments/final_ddot_sustainability_plan_07-October-2010.pdf

382 Washington Metropolitan Area Transit Authority, “Sustainability Initiative,” accessed November 21, 2017. <https://www.wmata.com/initiatives/sustainability/sustainability-initiative.cfm>

383 Washington Metropolitan Area Transit Authority, “Metro Sustainability 2017.” <https://www.wmata.com/initiatives/sustainability/upload/2017-Annual-Sustainability-Report.pdf>

from vehicles. To significantly reduce GHG emissions from passenger vehicles, the District must also decarbonize the electricity the District consumes. Indeed, the very concept of EVs as zero-emission transportation mode assumes and requires a decarbonized electricity grid. Actions focused on this objective are included in the Plan's Clean and Renewable Energy Supply section.

6.1.2 RECOMMENDED ACTIONS

6.1.2.1 ELECTRIC VEHICLE READINESS

EV.1 Adopt an EV-ready building code

Action: Update the DC Construction Codes to require buildings to install EV charging equipment and/or the ability to install future EV charging equipment.

Relevance: More than 80% of EV charging occurs at home or work. To achieve the level of EV adoption necessary to achieve the District's long-term GHG reductions, property owners will need to equip many more residential and commercial parking spaces with charging stations. Both the perceived and actual availability of chargers are critical to increasing consumer comfort with EVs, and thus the willingness to purchase one. While the installation of charging infrastructure can be costly, work in other jurisdictions indicates that it is significantly more cost-effective to install EV charging stations if the electrical infrastructure is already in place.³⁸⁴ As such, ensuring building parking and electrical systems are designed to accommodate future EV charging stations will improve the overall cost-effectiveness of achieving the District's GHG reduction target.

The District currently offers financial incentives for EV charging station installations, but does not require charging stations or associated electrical infrastructure to be installed.³⁸⁵ The District's Green Construction Code requires that new buildings and substantial building alterations install a minimum number of sustainable building requirements from a set of options. One option is the installation of one electric vehicle charging station (or the equivalent electrical infrastructure suitable for a future installation of electric vehicle charging stations) for every 30 parking spots. The DC Green Construction Code applies to construction in residential and commercial buildings greater than three stories and 10,000 square feet. Thus far, however, it appears only one development has elected to install an EV charger or the required electrical infrastructure.³⁸⁶

Details: At least three other cities have adopted building codes with EV requirements. Los Angeles requires that all residential buildings be equipped with either an EV charging outlet or the infrastructure necessary to install an outlet in the future.³⁸⁷ The code requires all one-to-two family residential buildings to provide at least one EV charger-ready space, while all other residential buildings and high-rise commercial buildings must ensure that 5% of parking stalls are EV charger-ready. Similarly, San Francisco's building code requires all new structures to be wired for EV charging stations, while Vancouver (Canada) requires a minimum of 20% of parking stalls in multi-family residential buildings to include a receptacle for EV charging.^{388,389} The City of

³⁸⁴ California Department of Housing and Community Development, 2014, Electric Vehicle Ready Homes: Report on Electric Vehicle Readiness Study, http://www.hcd.ca.gov/codes/calgreen/ev_readiness_report_complete.pdf.

³⁸⁵ Residential stations are eligible for a \$1,000 tax credit and public charging stations are eligible for a \$10,000 tax credit (up to 50% of purchase and installation cost).

³⁸⁶ Conversation with DOEE Staff on Feb 10, 2016.

³⁸⁷ U.S. Department of Energy Alternative Fuels Data Center, 2014, Los Angeles Sets the Stage for Plug-In Electric Vehicles, <http://www.afDC.energy.gov/case/1002>

³⁸⁸ San Francisco requirements from Lutsey, N., Searle, S., Chambliss, S., Bandivadekar, A., 2015.

³⁸⁹ City of Vancouver, 2012, Electric vehicle charging requirements, <http://vancouver.ca/home-property-development/electric-vehicle-charging-requirements.aspx>

Vancouver also requires developers to ensure that electrical rooms in these buildings provide sufficient space to contain the equipment necessary to provide EV chargers to 100% of stalls in the future.

The experience of these and other jurisdictions indicates that it is particularly difficult to get EV charging infrastructure installed at multi-family residential buildings.³⁹⁰ As noted above, it is also more expensive to install chargers once the building has been constructed. Given that buildings stand for several decades, it is important for the District to take steps now to prepare for the transportation needs of the future. As such, the following recommendations are suggested:

- Update the building code to require single-family, multi-family, and commercial buildings to install a minimum number of EV charging stations and/or provide the electrical infrastructure (e.g., conduits, outlets) necessary for the installation of future charging stations.
- To gain value from the visibility of charging stations, ensure that the code requires EV charging stations and not only the infrastructure for future stations. Apply these rules to major retrofits to parking areas as well.
- Ensure building systems can accommodate EV future charging infrastructure across the entire parking lot.
- This requirement should be enforced by the DCRA Green Building Division. This will simplify compliance and reduce the risk of redundancy or conflicts with other parts of the DC Construction Codes and laws.

In designing EV building code requirements, the District may need to consider the electrical grid's ability to absorb large EV loads. For example, an analysis of California's electrical system showed that its grid could reliably handle 240 volt/40 amp charging stations, but that it could become overloaded with 240 volt/80 amp stations.³⁹¹ The District's grid should be evaluated in a similar way, particularly during future code reviews as the grid is upgraded, EV market share expands, and EV charging technology evolves. This action should also be coordinated with the adoption of an EV-ready parking lot requirement (Action EV.2) to ensure that requirements are mutually reinforcing and cover both building-sited and standalone parking lots. Of course, the cost impact of EV charging infrastructure and cost-reduction strategies should be considered in implementing this action.

³⁹⁰ California Department of Housing and Community Development, 2014

³⁹¹ Herron, D., 2014, California soon to require all new housing to be "EV Capable", with conduit for electric vehicle charging infrastructure, <http://bit.ly/1TBFPQ0>

Next Steps

- 1 During the next code cycle update, add a requirement for EV charging stations and EV-ready infrastructure in new and renovated buildings. Develop the code requirements with an understanding of the scale of EVs required in the future for the District to achieve its GHG targets.
- 2 Review the requirement during each code cycle and update it to steadily increase requirements, account for EV adoption and the projected number of EVs necessary to achieve the District's GHG targets, and account for developments in EV charging infrastructure technology.
- 3 Work with Pepco to continue to assess the ability of the electrical grid to absorb more and higher power charging stations. This work should be conducted by DOEE staff focused on EV infrastructure planning and Pepco, in coordination with the Construction Codes Coordinating Board (CCCB) and DCRA's Green Building Division.

EV.2 Adopt an EV-ready parking lot requirement

Action: Update DC Construction Codes and related regulations to require new and renovated parking garages and parking lots to install EV chargers and/or the electrical infrastructure necessary to install EV charging infrastructure in the future.

Relevance: While they are used less than residential and workplace chargers, publicly available EV chargers (e.g., in parks and shopping centers) play a valuable role in facilitating a long-term transition to EVs in that they help build consumer confidence that electric vehicles can meet their travel needs. Parking lot charging stations increase consumer awareness of and comfort with EV technology, which can help increase adoption.

Requiring parking lots to install EV chargers and/or infrastructure helps ensure publicly accessible parking lots can add EV chargers in the future more easily and at a lower cost. Further, conduit installation costs can be 95% lower if carried out during initial construction or ongoing retrofit than as a standalone construction project.³⁹² However, the District currently has no requirements for publicly accessible parking lots to be EV-ready. Rather, publicly available EV chargers have been installed voluntarily by businesses or in partnership with the District.

Details: Two precedents form a basis for this recommendation. First, New York City requires a minimum of 20% of parking spaces in open lots and garages be embedded with the conduits necessary to install EV charging stations in the future.³⁹³ This applies to both new construction and lots undergoing upgrades, except for retail parking spaces. Similarly, California began a process of updating its construction codes in May 2016, and is expected to require all parking lots to have a minimum number of EV charger-ready spots.³⁹⁴ The precise number of spots is contingent on the size of the parking lot, but covers approximately 6% to 12% of stalls. The following recommendations draw on lessons from these examples:

³⁹² plugincars, 2013, New York Requires Garages and Lots to be Built EV-Ready, <http://www.plugincars.com/new-york-requires-lots-and-garages-be-built-ev-ready-129063.html>

³⁹³ Ibid.

³⁹⁴ Final Express Terms for Proposed Building Standards of the California Building Standards Commission, 2015, <http://www.documents.dgs.ca.gov/bsc/2015TriCycle/Commission-Review/Jan-2016/BSC-04-15-FET-Pt11.pdf>

- Update the District's Construction Codes to require that a minimum percentage of parking stalls in all parking lots contain EV chargers, and is wired to add EV charging stations in the future.
- Apply the new codes to all new parking lots and parking lots in the process of being upgraded.
- In a future code cycle, incorporate a mandatory requirement for EV chargers to be installed in new and renovated parking lots and parking garages, to increase awareness of and comfort with EVs.
- Work with DDOT and other District and Federal agencies governing public space to ensure that these requirements are also applied to District-owned parking lots and other relevant public lots.

This action should be coordinated with the adoption of an EV-ready building code (Action EV.1) to ensure the requirements are mutually reinforcing and cover both building-sited and standalone parking lots. The ways in which this action may align with other recommendations to pursue an EV-only car sharing fleet (Action EV.6) should also be considered.

Next Steps

- 1 During the next code cycle update, add a requirement for new and renovated parking lots and garages to install a minimum percentage of EV-ready spots and EV charging stations. As with the EV-ready building code above, develop these requirements with an understanding of the scale of EVs required in the future for the District to achieve its GHG targets, as well as the grid's capacity to absorb new EV loads.
- 2 Review the requirements during each code review and update it to steadily increase requirements, while accounting for EV adoption, the projected number of EVs necessary to achieve the District's GHG targets, and developments in EV charging infrastructure technology. This work should be conducted by DOEE staff focused on EV infrastructure planning and Pepco, in coordination with the Construction Codes Coordinating Board (CCCB) and DCRA's Green Building Division.

6.1.2.2 ELECTRIC VEHICLE ADOPTION

EV.3 Implement an EV bulk buy program

Action: Partner with one or more automakers to offer District residents an EV bulk buy program.

Relevance: As noted above, the District's small size and high land values restrict the possibility of any new vehicle dealerships.³⁹⁵ Rather, the District is dependent on what dealerships in neighboring states offer. Furthermore, District residents cannot take advantage of those state incentives if the vehicles are registered in the District. As such, drivers may be even less likely to be interested in EVs than drivers in other regions. To overcome this barrier, the District must find innovative ways to increase both the availability and attractiveness of EVs to local drivers.

An EV buy program offers a feasible near-term solution: in addition to generating a one-time increase in the number of EVs on District roads, the program can increase the visibility of EVs, thus potentially improving consumer awareness of and comfort with the vehicles.

Details: Boulder, Colorado (and nearby Adams County and Denver counties) implemented a bulk buy program of both EVs and solar panels in 2015, to great success. Boulder collaborated with Nissan North America and Boulder Nissan to offer the 2015 Nissan LEAF S with Quick Charge Package for more than \$8,000 below the retail price (\$23,461 vs. \$31,810), before state and federal tax credits (which total \$12,500).³⁹⁶ Nissan Boulder sold 150 vehicles in just two months (a substantive increase over the monthly average of 15-20 sales), with an additional 300 customers in the pipeline. Given the success of the program, Boulder is currently investigating a second EV bulk buy program with Nissan and other automakers.³⁹⁷

Drawing on the results of this program, the District should take the following actions:

- As in Boulder, the District may wish to align the EV bulk buy program with EV chargers and solar panels. If so, the District should align this bulk buy program with the recommendation to implement a targeted solar proliferation strategy in the Plan's Clean and Renewable Energy Supply section.
- This program should also be used as an opportunity for the District to develop EV information materials and introduce the vehicle purchase incentive recommended below. Importantly, the program will need to be coordinated with the next recommendation (Install an EV Showcase and Purchase Center) to ensure the two programs support rather than undermine the cost-effectiveness of one another.

A well-orchestrated bulk buy program will require no government funding (other than staff time), and will result in an increase in the number of EVs on the road and the overall presence of EVs in the region. The program can be operated by the District or by another organization that is found through a competitive bid RFP process. Consumers will also benefit from lower EV pricing, while participating automakers can enjoy substantially lower acquisition fees, marketing costs, transaction costs, and failed leads.³⁹⁸

³⁹⁵ Discussion with DOEE staff, March 18, 2016.

³⁹⁶ RMI Outlet, 2015.

³⁹⁷ Discussion with Boulder planning staff, February 29, 2016.

³⁹⁸ RMI Outlet, 2015, What Electric Vehicles Can Learn From the Solar Market, <https://rmi.org/electric-vehicles-can-learn-solar-market>

Next Steps

- 1 Assign DOEE staff to connect with Boulder to learn how that city designed and managed its program. Determine which staff may be best suited to lead the initiative, how the discount was arranged, and whether a minimum number of buyers would need to be procured.
- 2 Within the next year, coordinate with one or more automakers to participate in the program. Depending on the success of the program's first round, repeat it with additional automakers, as is currently being explored in Boulder.
- 3 To increase the value of District Government staff efforts on this action, consider aligning either the first or second round of this program with the marketing involved in the solar proliferation strategy.

EV.4 Establish an EV Showcase and Purchase Center

Action: Partner with automakers and local organizations to install an EV-only Showcase and Purchase Center in the District.

Relevance: While the EV bulk buy program recommended above offers a short-term solution to the low accessibility of EVs, an EV Showcase and Purchase Center offers a more permanent and effective solution over the long-term.

The Center would offer prospective EV drivers access to a wide variety of EV models from several automakers. It would allow residents to learn about and consider the prospect of purchasing an EV over a longer period, potentially generating additional sales than would be generated during a short-term bulk buy program. Finally, such a program will increase EV adoption and improve consumer awareness of, comfort with, and interest in EV technology. It also creates an opportunity to collect information about prospective EV buyers in the District and set up opportunities to potentially contact them in the future, thus laying the groundwork necessary for mass adoption of EVs in the future.

Details: This action will require the District to contract a qualified organization to set up and manage an EV Showcase and Purchase Center to sell EVs and/or generate customers for online purchases. Such a program would be unique to the District and suitable given its lack of vehicle dealerships. It has flagship program potential that can demonstrate the District's leadership in facilitating a long-term transition to a zero-emission passenger vehicles and a low carbon economy. Such a showroom would offer residents the opportunity to learn about, test drive, and purchase EVs without leaving the District. The District could also claim that the only new vehicles available for sale in the District are EVs.

Based on the above, the following actions should be taken:

- Design the showcase to maximize visibility and accessibility. The location should be determined by balancing costs and the opportunity to maximize visitors, including commuters from outside the District. The hours of operation should be set to be convenient for people to visit, including evenings and weekends.

- Partner with as many automakers as are willing to offer their EVs for purchase through this program and make models available for test drives. To reduce costs, test drive vehicles could be kept at a separate location, such as a government parking lot. Test drives could be scheduled with prospective drivers either over the phone, online, or in the showcase center.
- Share costs and other resources required to develop and run the center with participating automakers.
- Develop information regarding what it is like to own an EV in the District, including benefits (e.g., fuel savings, high occupancy vehicle lane access), financial incentives, the ability of vehicles to meet daily driving needs, and the placement of public EV charging stations. These materials could also be designed to address misperceptions and misunderstandings about EV ownership that may be limiting purchases.

Under this program, automakers would be responsible for providing clear and easy-to-understand marketing materials. These materials must be customized to provide prospective buyers the opportunity to easily understand both basic and detailed information about the vehicles, with a focus on the types of information that consumers typically have access to at dealerships. Rather than provide a staff member, automakers should provide a phone number that prospective buyers can call to ask questions about specific vehicles. Customers can then have more direct contact with the automakers through the test-drive program, whereby a representative of the automaker can be scheduled to join prospective purchasers on a test drive.

The program should also be coordinated with the implementation of an EV bulk buy program to ensure that the two programs support rather than undermine one another. It should also be coordinated with a financial purchase incentive adopted by the District (see below) and the development of any information and marketing materials.

Next Steps

- 1 Within the next year, assign DOEE staff with the support of other key internal District Government stakeholders to outline a public-private partnership proposal that the District can take to all automakers offering EVs, and release a request for proposal for the development and management of the center.
- 2 Outline the overall programming of the initiative and potential roles and contributions of each party.
- 3 By year two, implement the showcase program alongside the financial purchase incentive recommended below. The program will likely require coordination between staff involved in EV policy and programming alongside District Government staff that run marketing campaigns and events.

EV.5 Provide an electric vehicle purchase incentive

Action: Adopt a financial incentive for the purchase of EVs registered in the District.

Relevance: While they form an important part of EV adoption strategies in other regions, strong vehicle purchase incentives have not been a part of the District's EV adoption policies, again due to the lack of new vehicle dealerships in the District.³⁹⁹ However, the District does exempt vehicles with a fuel economy above 40 mpg (including EVs) from vehicle title fees (typically 6% to 8% of the vehicle price), and offers an income tax credit for vehicles converted from petroleum to a qualified clean fuel (including electricity).^{400,401}

In implementing an EV bulk buy program and installing an EV Showcase and Purchase Center, the District may require a financial purchase incentive as a short-term tool to convince residents to buy EVs over conventional petroleum-fueled vehicles.

Details: Purchase incentives that decrease the upfront cost of EVs are one of the most common tools used by states to generate EV sales. The effect of these incentives on vehicle sales varies between regions. For example, Colorado offers one of the highest state vehicle credits (up to \$6,000), but this has not translated into high EV adoption.⁴⁰² Georgia, however, saw very high EV sales while it had a tax credit in place, but sales collapsed when the credit was removed midway through 2015.⁴⁰³ For a local comparison, Maryland offers an excise tax credit of up to \$3,000 and, like the District, less than 1% of new vehicles sold in the state are EVs.⁴⁰⁴ California has the highest market share at around 3.5% in 2015.

Based on these programs, the District should take the following actions:

- Adopt a financial purchase incentive designed to prioritize vehicles that offer the largest GHG reductions (e.g., full battery electric vehicles should receive a higher incentive than plug-in hybrid electric vehicles with a gasoline engine to back up the battery).
- The size of the purchase incentive needed may depend on vehicle discounts the District can arrange with automakers through both the EV adoption recommendations above, most importantly the installation of an EV Showcase and Purchase center.

As part of this, the District should consider providing income-based EV subsidies to improve LMI community access to sustainable transportation options.

³⁹⁹ Overview of EV strategies in other regions from Lutsey, N., Searle, S., Chambliss, S., Bandivadekar, A., 2015.

⁴⁰⁰ Vehicle title fee exemption from DMV (2016) Green Driver State Incentives in Washington DC, <http://www.dmv.org/washington-dc/green-driver-state-incentives.php>

⁴⁰¹ Income tax credit covers 50% of the conversion cost up to \$19,000. National Conference of State Legislatures, 2015, State Efforts Promote Hybrid and Electric Vehicles, <http://www.ncsl.org/research/energy/state-electric-vehicle-incentives-state-chart.aspx>

⁴⁰² Lutsey, N., Searle, S., Chambliss, S., Bandivadekar, A., 2015.

⁴⁰³ Caputo, M., 2015, Georgia EV sales sputter without tax credit, <http://www.marketplace.org/2016/01/08/world/georgia-ev-sales-sputter-without-tax-break>

⁴⁰⁴ Lutsey, N., 2015, Transition to a Global Zero-Emission Vehicle Fleet: A Collaborative Agenda for Governments.

Next Steps

- 1 In developing an EV bulk buy program and/or EV Showcase and Purchase Center, determine the level of discount the District can obtain from the automakers.
- 2 Review financial incentives in other jurisdictions and determine what level of financial incentive may be required to achieve a high level of EV adoption, and how to structure a potential income-based incentive for residents in LMI communities.
- 3 Adopt a financial purchase incentive at the level required to make the bulk buy and Purchase Center actions viable and significantly increase vehicle adoption in the District.

EV.6 Pursue an EV-only car sharing fleet

Action: Contract one or more car share operators to supply an EV-only car share fleet in the District.

Relevance: The District is an excellent candidate for car sharing programs given its small geographic size, high land use density, and high number of households that do not own personal vehicles. These characteristics may also make it ideal for an all-electric car sharing fleet. Car sharing of any kind helps the District decrease congestion, achieve mode share objectives, and decrease GHGs and local air pollution. Implementing an EV-only car share program will further decrease GHGs and local air pollution while helping increase awareness of EVs as a passenger vehicle technology that is ready to meet individuals' driving needs. Three corporate and two peer-to-peer car sharing programs are already available in the District, but none of these are fully electric.⁴⁰⁵

Details: The District can follow in the footsteps of the increasing number of international cities offering EV-only car sharing fleets. Paris launched the first all EV car sharing program with Autolib' in 2011. The program now has 3,000 vehicles and more than 150,000 members, prompting London to announce in 2015 that it, too, would offer a full EV car sharing fleet.⁴⁰⁶ In September 2015, Indianapolis began its own EV-only car sharing fleet with BlueIndy, while Montreal issued a call for proposals to invite companies to provide a fully electric car sharing fleet starting in 2016.^{407,408} Montreal's existing car sharing programs welcomed the announcement, including Car2Go, which already has fully electric fleets in Amsterdam, San Diego, and Stuttgart. The call for proposals resulted in the launch of Montreal's Téo Taxi, an app-based ridehailing service offering all-electric vehicles with free Wi-Fi for the same cost as a taxi.⁴⁰⁹ On the west coast of the continent, Los Angeles is piloting a car-sharing program in 2016 targeted to low-income residents, with plans for 80% of the vehicles to be EVs.⁴¹⁰

⁴⁰⁵ ZipCar, Car2Go, and Enterprise CarShare, as well as Getaround and Relayrides.

⁴⁰⁶ Werber, C., 2015, The electric car-sharing service that swept through Paris is coming to London, <http://qz.com/428116/the-electric-car-sharing-service-that-swept-through-paris-is-coming-to-london/>

⁴⁰⁷ Matlack, C., 2015, Paris Is Sharing Electric Cars by the Thousand. Will It Play in Indianapolis?, <http://www.bloomberg.com/news/articles/2015-09-17/paris-is-sharing-electric-cars-by-the-thousand-will-it-play-in-indianapolis->

⁴⁰⁸ Madger, J., 2015, Montreal looks into setting up an electric-car sharing service, <http://montrealgazette.com/news/local-news/montreal-looking-into-setting-up-an-electric-car-sharing-service>

⁴⁰⁹ <http://teomtl.com/en/>

⁴¹⁰ Spector, J., 2015, L.A.'s Bold Plan to Bring Car-Share to the Poor, <http://www.citylab.com/cityfixer/2015/07/la-bold-plan-to-bring-car-share-to-the-poor/400031/>

Key to the success of this program is the availability of public charging infrastructure and the ability to encourage enough membership.^{411,412} The District should learn from the experiences of other cities, and then collaborate with the prospective car-share company (or companies) to determine how to install an adequate amount of EV chargers and market the program to residents. The District should additionally work to align the EV charger installation with efforts to make EV chargers available to more people and increase the visibility of EVs to citizens. Finally, given the proximity of the District to neighboring states and cities, as well as the high commuter population, the District Government should seek opportunities to coordinate with these governments and regional transit providers to develop an electric car share system that can augment existing interregional transit options, thus making it attractive to more commuters.

Next Steps

- 1 In 2018, assign staff from DOEE and the District Department of Transportation (DDOT) to connect with staff from the cities identified above, as well as their EV car share providers, regarding their experience with an EV-only car sharing fleet.
- 2 Engage with existing car share providers regarding the District's intention to establish a 100% electric car sharing fleet and gauge their interest in participating. If an existing car share company is willing to provide an electric fleet (steadily shifting to 100% electric), the next step may not be necessary.
- 3 As needed, release a call for proposals for the provision of an EV-only car share fleet in the District. As needed, consult with Pepco regarding the ability of the electrical grid to handle additional loads. Aim to have an EV-only fleet in operation by 2020.



⁴¹¹ Importance of public infrastructure from Madger, J., 2015.

⁴¹² Importance of encouraging adequate membership from Werber, C., 2015.

6.1.2.3 SHIFTING TO ZERO EMISSION TRANSIT VEHICLES

EV.7 Set target for reducing transit bus emissions 65% per vehicle mile by 2032

Action: Enact legislation requiring a 65% reduction in transit bus fleet GHG emissions per vehicle mile from a 2013 baseline by 2032.

Relevance: As part of its Sustainability Initiative, WMATA adopted a sustainability performance target of achieving a 50% reduction in GHG emissions per vehicle mile from a 2013 baseline by 2025. With 53% of WMATA and 4% of DDOT vehicle miles served by electricity-powered rail service, renewable energy from local electricity providers is key to achieving this goal.⁴¹³ However, buses serve 48% of combined annual vehicle miles traveled by both agencies.⁴¹⁴ Zero-emission buses, therefore, have a critical role to play in significantly reducing transit emissions in DC. Transit agencies also have generally more control over the propulsion type of their buses than the fuel stock of local electricity suppliers.

Stated goals such as this one, and that already expressed in WMATA's Sustainability Initiative, communicate to transit bus manufacturers what service providers will be seeking in future bus procurements.⁴¹⁵ As the nation's capital, the impact of a GHG emissions target such as this can also go further in setting the course for other cities and transit service providers across the country.

Details: **Figure 19** and **Figure 20** display forecasts of five future scenarios of bus fleet energy consumption and tailpipe GHG emissions at WMATA and DDOT through 2032.⁴¹⁶ Scenario 1, a baseline scenario, estimates transit bus energy consumption and emissions, based on current vehicle procurement planning from both service providers.^{417,418} Scenarios 2, 3, 4, and 5 present scenarios in which all new buses acquired through 2032 have one of four propulsion types:

- Scenario 1: Fleet as Currently Planned (baseline)
- Scenario 2: Clean Diesel
- Scenario 3: Diesel/Electric Hybrid
- Scenario 4: Compressed Natural Gas (CNG)
- Scenario 5: Electric

As shown in **Figure 20**, these scenarios demonstrate that electric buses have the greatest potential for reducing transit bus fleet emissions; scenario 5 shows the depth of bus emissions reductions known to be possible today, under current fleet purchasing practices.⁴¹⁹ In addition, these scenarios show that a significant investment in electric buses is necessary to achieve this 65% emissions reduction target by 2032.

See Appendix A1.2.3.4. for forecasts of criteria air pollutants, based on these scenarios.

⁴¹³ Federal Transit Administration, "2016 Service," National Transit Database, <https://www.transit.dot.gov/ntd/data-product/2016-service>

⁴¹⁴ Federal Transit Administration, "2016 Service," National Transit Database, <https://www.transit.dot.gov/ntd/data-product/2016-service>

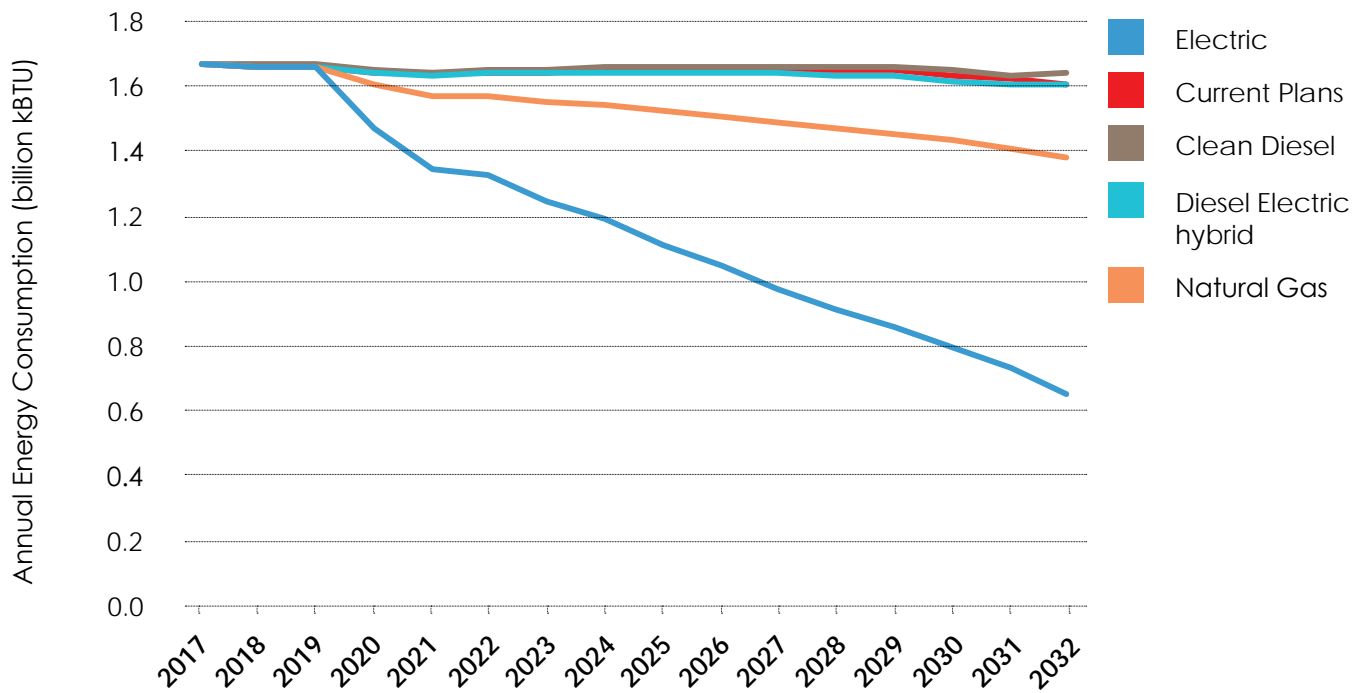
⁴¹⁵ Washington Metropolitan Area Transit Authority, "Sustainability Initiative," accessed November 21, 2017, <https://www.wmata.com/initiatives/sustainability/sustainability-initiative.cfm>

⁴¹⁶ The scenarios presented are based on the mode share forecast. Achieving the mode share target increases the differences between the scenarios.

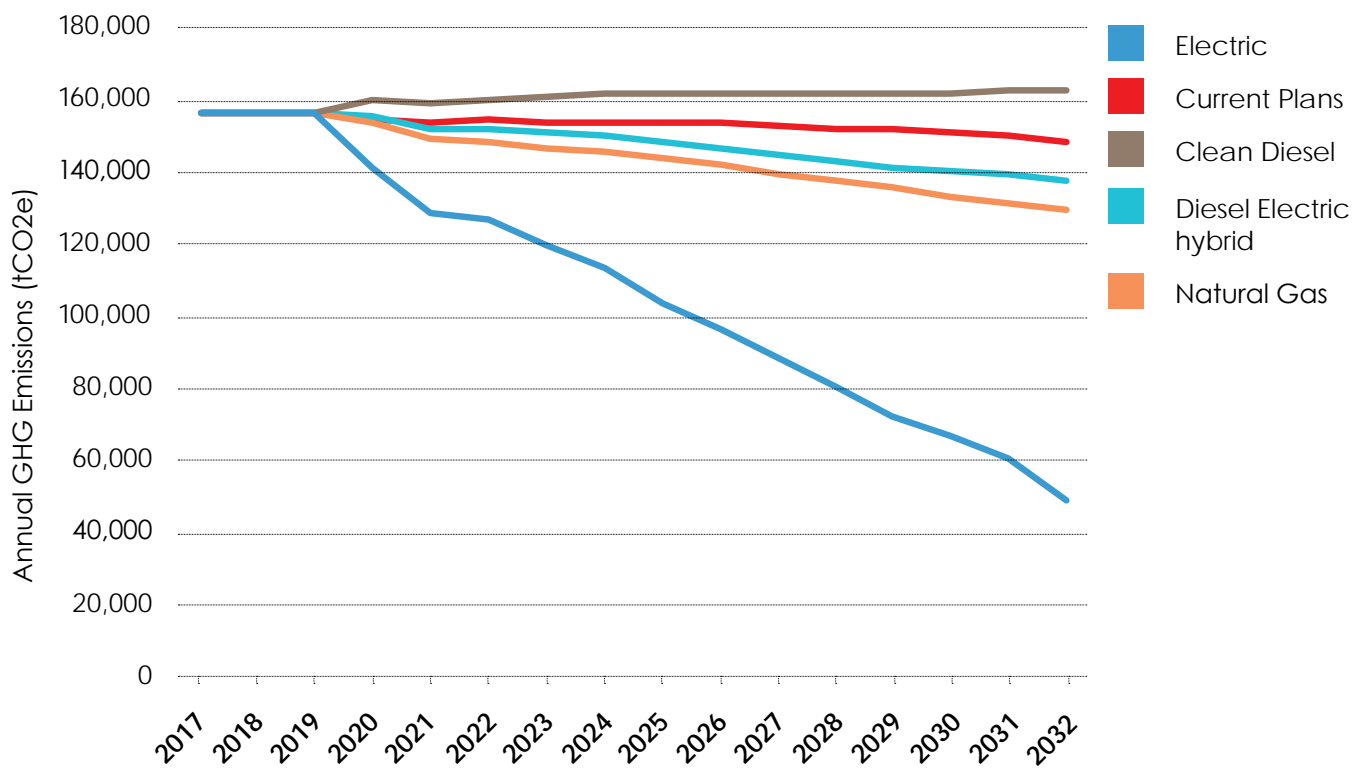
⁴¹⁷ Washington Metropolitan Area Transit Authority, "Customer Service, Operations and Security Committee, Action Item III-A, Adoption of Bus Fleet Plan," September 14, 2017, <https://www.wmata.com/about/board/meetings/board-pdfs/upload/3A-Metrobus-Fleet-Plan-TQ-POST.pdf>

⁴¹⁸ District Department of Transportation, "DC Circulator 2017 Transit Development Plan Draft," September 2017, <http://www.dccirculator.com/wp-content/uploads/2017/10/DC-Circulator-2017-TDP-Update-101818.pdf>

⁴¹⁹ See Appendix A1.2.3.4. for a complete list of transit fleet bus emissions forecast assumptions.



↑ **Figure 19:** Annual Energy Consumption Forecast, WMATA and DDOT Buses



↑ **Figure 20:** Annual Greenhouse Gas Emissions Forecast, WMATA and DDOT Buses

Next Steps

- 1 In 2018, assign staff from DOEE and the District Department of Transportation (DDOT) to connect with staff from the cities identified above, as well as their EV car share providers, regarding their experience with an EV-only car sharing fleet.
- 2 Engage with existing car share providers regarding the District's intention to establish a 100% electric car sharing fleet and gauge their interest in participating. If an existing car share company is willing to provide an electric fleet (steadily shifting to 100% electric), the next step may not be necessary.
- 3 As needed, release a call for proposals for the provision of an EV-only car share fleet in the District. As needed, consult with Pepco regarding the ability of the electrical grid to handle additional loads. Aim to have an EV-only fleet in operation by 2020.

EV.8 Pursue funding options to subsidize electric transit buses, and electric charging infrastructure

Action: Identify funding options to subsidize the purchase of electric transit vehicles and electric charging infrastructure.

Relevance: Starting prices for electric bus orders today are generally over \$750,000, while diesel buses can be in the range of \$400,000-\$450,000. In addition to the gap in vehicle purchase price, transit service providers also need to acquire new vehicle charging infrastructure to recharge vehicle batteries. This gap in costs makes the conversion to an all-electric fleet a challenging endeavor for any transit agency, but peer service providers across the country are pursuing it.^{420,421,422,423} Legislation setting emissions reduction requirements signal to bus manufacturers what transit service providers will require in future bus purchase orders. The dedication of financial resources demonstrates that service providers will not only have higher future standards, but also will have funding to support advanced technologies.

Details: According to the emissions forecast in Figure 20 a significant percentage of both WMATA and DDOT bus fleets will need to be electric buses to meet a target of a 65% reduction in emissions per vehicle mile. Using this target as guidance, the District Government can estimate funding need and work to align appropriate funding sources.

⁴²⁰ Fryer, Alex, "New report charts course to zero-emission, carbon-neutral King County Metro bus fleet," King County, March 1, 2017. <http://kingcounty.gov/elected/executive/constantine/news/release/2017/March/01-metro-zero-emission.aspx>

⁴²¹ Scauzillo, Steve, "LA Metro commits to 100 percent electric buses by 2030," San Gabriel Valley Tribune, August 30, 2017. <http://www.sgvtribune.com/2017/07/28/la-metro-commits-to-100-percent-electric-buses-by-2030/>

⁴²² Foothill Transit, "Foothill Transit Announces All Electric Bus Fleet by 2030," May 24, 2016. <http://foothilltransit.org/foothill-transit-announces-all-electric-bus-fleet-by-2030/>

⁴²³ Antelope Valley Transit Authority, "Electric Bus Fleet Conversion," <http://www.avta.com/index.aspx?page=482>

Next Steps

- 1 Explore funding sources, both short- and long-term, that can be used to subsidize the procurement of electric buses and electric vehicle charging infrastructure by public transit agencies serving the District.
- 2 By 2020, establish a long-term subsidy program for electric transit buses and electric vehicle charging infrastructure

6.1.2.4 ANTICIPATING ELECTRIC AUTONOMOUS RIDEHAILING VEHICLE FUTURE

EV.9 Prepare for reduced parking demand near activity centers

Action: Prepare for reduced parking demand near activity centers in the District.

Relevance: Single-occupancy vehicle trips have the highest GHG emissions intensity per person-trip. They also come with the need for available space for car parking close to a person's origins and destinations. One of the most significant impacts AVs are poised to make on the urban landscape is on the need for and spatial relationships with parking.

Since AVs do not need to park near the destination of their passengers, the requirement of minimum car parking per individual property can become obsolete. Zoning requirements that shift to prioritizing space for people over car storage can encourage people to travel in ways that do involve car parking, such as public transit and active transportation, all of which have lower emissions intensities per trip than private car travel.

Details: Parking minimums are generally set per land use zone to satisfy an estimated peak demand for free parking.⁴²⁴ Removing and reducing these minimums enables developers to anticipate and even build for a future when pick-up and drop-off zones are valued more highly than parking spaces. In this way, properties can be built to make more space for active use by people, instead of car storage. As the absence and reduction of parking minimums allows developers to utilize existing parking capacity for more profitable uses by people, this encourages people to travel within the District by means that have lower emissions intensities per passenger trip.

Parking is often over-supplied currently in the District. The District Department of Transportation (DDOT) and the Office of Planning (OP) led a research effort starting in February 2014 to understand how parking utilization in multi-family residential buildings is related to neighborhood and building characteristics. According to the study, "on average, in the over 115 developments researched, only 60% of parking stalls are being used."⁴²⁵

⁴²⁴ Shoup, Donald C. "The Trouble With Minimum Parking Requirements," Transportation Research, Part A 33 (1999): 549-574, <http://shoup.bol.ucla.edu/Trouble.pdf>

⁴²⁵ Park Right DC, District of Columbia, accessed January 24, 2018, <http://parkrightdc.org/background.php>

In 2016, the District Government amended its zoning code to provide exemptions to minimum parking requirements in select locations.^{426,427} Expanding on this step can enable more property owners and developers to shape the built environment in a way that can prioritize pick-up and drop-off zones, over large vehicle storage facilities; this is conducive to fostering a shared-ownership model for AVs.

Next Steps

- 1 Monitor development patterns in cities that have eliminated parking minimums.^{428,429,430}
- 2 Support continuous updates and monitoring of parking supply data in the District.
- 3 Support zoning code revisions to expand the reduction of parking minimums in the District to all activity centers.
- 4 Explore further opportunities to eliminate or reduce parking minimums as demand shifts with market preferences, technology advancements, and the availability of alternatives to car ownership.

EV.10 Provide financial incentives encouraging shared autonomous vehicle travel

Action: Expand demand-based pricing for parking and high-demand corridors, District-wide.

Relevance: Parking pricing is a common tool for influencing travel behavior in high-demand areas. Enabling travelers to internalize the true cost of driving in the District can lead them to less emissions-intensive travel modes, such as carpooling, transit, and active transportation. As AVs come to market as a new mode of travel, a combination of road and parking pricing can incentivize shared AV use.

Details: A common and significant source of GHG emissions in urban communities like D.C. is from drivers circling the vicinity of their destinations in search for parking. In December 2017, the San Francisco Municipal Transportation Authority (SFMTA) found its pilot of demand-based parking pricing to be so successful that its board moved to implement the pricing mechanism citywide in January 2018. The pilot program, SFpark, demonstrated that demand-based pricing of public parking resulted in decreased time spent and vehicle miles traveled by drivers searching for available parking.⁴³¹ An indirect result of the lessened VMT from circling for parking is lowered GHG emissions. In DC, the Park Rite DC study found that price was found to have a significant impact on parking utilization and parking supply.⁴³²

⁴²⁶ Office of Zoning, "Zoning Handbook: Vehicle Parking," District of Columbia, accessed November 21, 2017. <http://handbook.dcoz.dc.gov/zoning-rules/general-rules/parking/vehicle-parking/>

⁴²⁷ 64 DCR 6110 (June 30, 2017). <https://dcregs.dc.gov/Common/DCMR/RuleDetail.aspx?RuleId=21298>

⁴²⁸ Strong Towns, "Progress on Removing Parking Minimums," accessed November 21, 2017.

<https://www.google.com/maps/d/viewer?mid=1fpQabG3XKvHHZYNIHQobUHjwulI&hl=en&ll=39.032575230163985%2C-96.36995452128917&z=4>

⁴²⁹ Poon, Linda, "Buffalo Becomes First City to Bid Minimum Parking Goodbye," CityLab, January 9, 2017.

<https://www.citylab.com/equity/2017/01/buffalo-is-first-to-remove-minimum-parking-requirements-citywide/512177/>

⁴³⁰ Schmitt, Angie, "Hartford Eliminates Parking Minimums Citywide," Streetsblog USA, December 13, 2017.

<https://usa.streetsblog.org/2017/12/13/hartford-eliminates-parking-minimums-citywide/>

⁴³¹ Jose, Ben, "San Francisco Adopts Demand-Responsive Pricing Program to Make Parking Easier," San Francisco Municipal Transportation Agency, December 5, 2017. <https://www.sfmta.com/blog/san-francisco-adopts-demand-responsive-pricing-program-make-parking-easier>

⁴³² http://parkrightdc.org/supply_price_opt.php

DDOT is currently piloting ParkDC, the District's own demand-based parking pricing system in Penn Quarter and Chinatown.⁴³³ This pilot is intended to shape future deployment of demand-based parking pricing throughout the District.⁴³⁴ By expanding its demand-based parking pricing system, the District Government can influence travel behavior, and also collect more data on how people travel in DC. This data can play a key role in further developing policies and infrastructure that foster a shared-ownership model of AVs, leading to further emissions reductions from transportation.

Next Steps

- 1 Direct DDOT to expand ParkDC, the District's demand-based parking pricing program, for publicly owned and operated motor vehicle parking facilities District-wide by 2020.
- 2 Support DDOT in monitoring parking utilization in public parking facilities, and adjusting parking pricing based on demand.

EV.11 Adjust approaches to managing curb space

Action: Amend right-of-way design standards pertaining to sidewalk and curb lane space.

Relevance: Autonomous vehicles have potential to significantly increase the movement of people in travel lanes, which could in turn lead to higher emissions outputs from the transportation sector, absent energy generation changes by power suppliers and vehicle manufacturers. If the District Government encourages the use of AVs as shared mobility resources, it can reduce the share of single-occupant vehicle trips, the most energy-intensive mode of travel.

Careful management of curbside space can limit the potential for higher levels of emissions and congestion, regardless of a vehicle's energy source. A key part of managing right-of-way to reduce the share of single-occupant vehicle trips is using metrics that better reflect this. Replacing measures of vehicle delay in the District Design and Engineering Manual with measures of vehicle miles traveled, can better equip the District Government in assessing road design changes to favor high-occupancy and active transportation trips.

Details: Streets behave differently throughout the day, with various activities being more and less active at different hours. Delivery trucks occupy many loading zones near restaurants and shops in early morning and late night hours, commuters build up road traffic during peak commute hours, and pedestrian traffic bustles during lunch and evening hours as people eat, drink, and socialize.

Right-of-way design standards that prioritize the use of curbside road space for vehicle parking encourage single-occupancy vehicle trips by providing opportunities for cars to be stored in space near a person's destination. AVs present the opportunity to prioritize curbside space for people walking and bicycling, and boarding or departing mass transit and shared-mobility services, with less of a perceived impact on independent motorists.

⁴³³ Dey, Sourmya, "ParkDC: Penn Quarter/Chinatown: Multimodal Value Pricing Pilot and Curbside Management, Program Overview" District Department of Transportation, April 24, 2016. https://ddot.dc.gov/sites/default/files/dc/sites/ddot/page_content/attachments/E1_parkDC_publicpresentation_forDDOTwebsite_2016-04-24.pdf

⁴³⁴ District Department of Transportation, "Multimodal Value Pricing Pilot for Metered Curbside Parking – Penn Quarter/Chinatown," accessed November 20, 2017. <https://ddot.dc.gov/page/multimodal-value-pricing-pilot-metered-curbside-parking-penn-quarterchinatown>

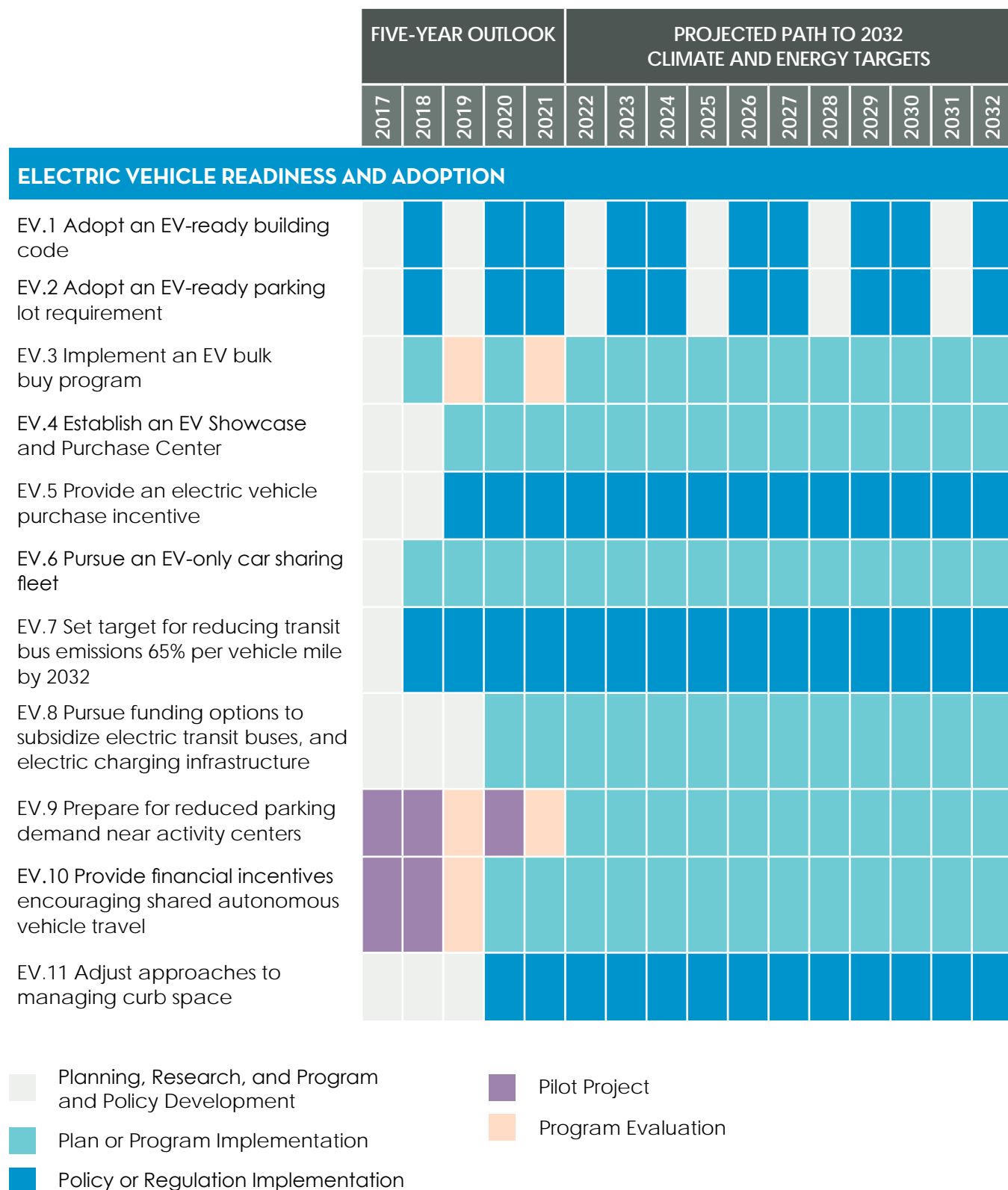
In addition, this is an opportunity to amend transportation design metrics to better assess desired behaviors. Replacing measures of road level of service (LOS) with measures of vehicle miles traveled (VMT) can better reflect how future right-of-way changes impact single-occupant vehicle travel, as well as emissions. .

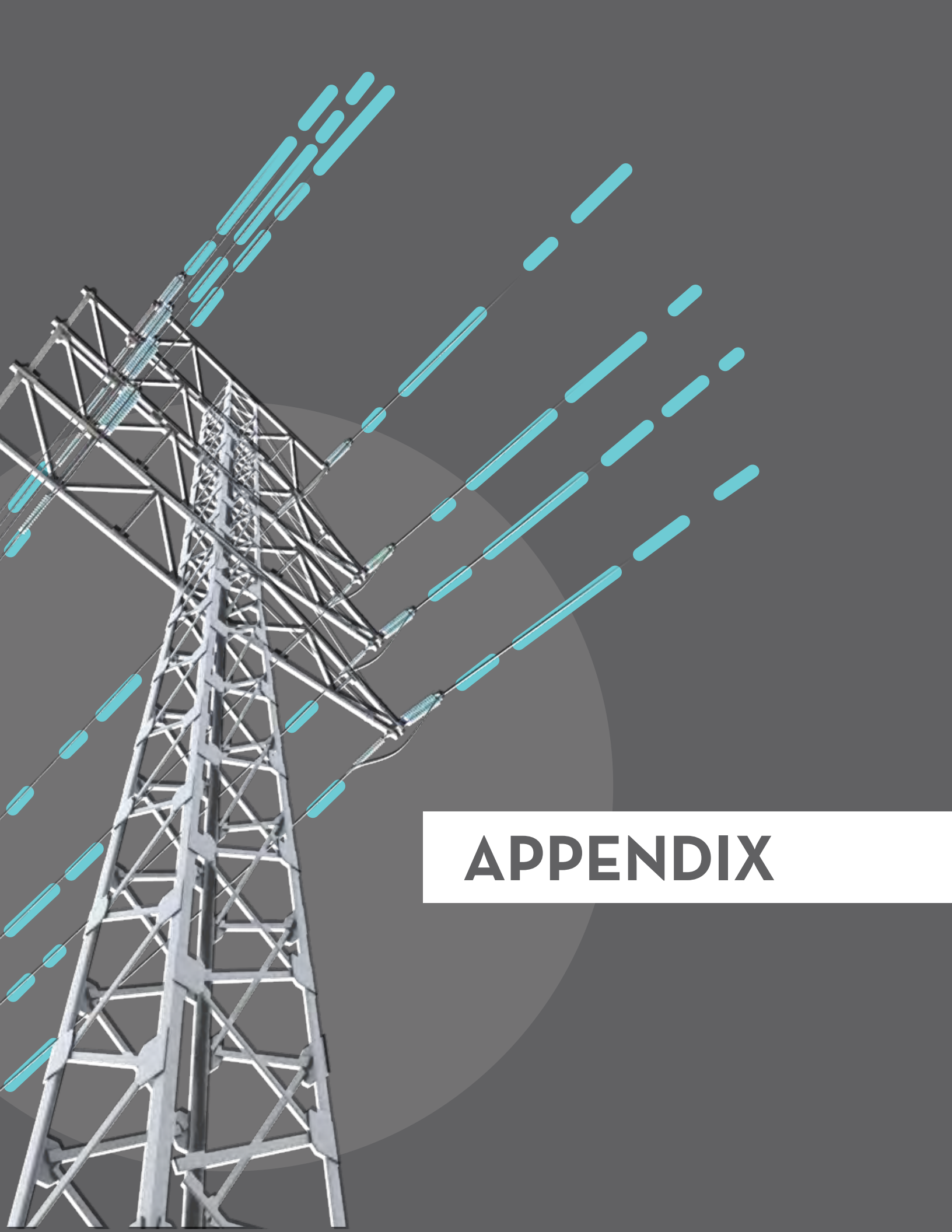
Next Steps

- 1 Amend design standards for right-of-way space in the District Design and Engineering Manual by 2020 to preference wider sidewalks, bicycle facilities, and transit lanes to anticipate and encourage higher-occupancy vehicle travel.
- 2 Amend the District Design and Engineering Manual by 2020 to replace measures of LOS with measures of VMT.
- 3 Phase in allocations of more curb space to passenger loading, rather than parking. On roads with bike lanes or transit service, amend loading zone design standards to reduce conflicts with active transportation and high-occupancy vehicles.
- 4 Ensure that local laws and plans pertaining to the operation of AVs and the safety of people walking and bicycling necessitate AVs adhering to laws and plans protecting people walking and bicycling in the public right-of-way.
- 5 Monitor curb space utilization by time and type of use to assess how it is currently used, and where it can be re-assigned, priced, or regulated to encourage higher occupancy motor vehicle travel, especially by AVs. Investigate creating EV-only waiting/pick-up/drop-off areas.
- 6 Monitor current interactions between ride-hailing vehicles and people biking and walking, to assess relative changes in right-of-way safety for people in a shared autonomous future.
- 7 Monitor the outcomes of research by the National Academy of Science Transportation Research Board on the impact of AVs on land use.⁴³⁵

⁴³⁵ "Request for Proposals on Impact of Transformational Technologies on Land Use and Transportation," National Academy of Sciences Transportation Research Board, accessed January 24, 2018, <https://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=4364>

6.1.3 ELECTRIC VEHICLE READINESS AND ADOPTION ROADMAP





APPENDIX



MODEL OVERVIEW AND ASSUMPTIONS

A1.1 MODEL PURPOSE AND OVERVIEW

The consultant team developed an Excel-based energy and GHG emissions model for the Plan. The model accounts for all energy and GHG emissions in the District and focuses on representing energy supply, buildings, and transportation. The consultant team used the model to understand current energy and emissions, estimate future energy and emissions, and quantify the potential impact potential actions would have on different sectors. The structure, equations, and data inputs have been discussed with and vetted by DOEE staff.

The Plan is intended to inform the District on how it can achieve its climate and energy targets (section 1.1). Given this purpose, the model was used to quantify actions in different ways. The team quantified specific programs and policies where actions are more directly quantifiable, such as the RPS and new construction codes. For actions that do not as easily lend themselves to direct quantification, the team focused on determining the scale of action required to achieve the District's climate and energy targets. This was then used to help inform policy and program development as well as collaboration with District Government representatives and others. The team took this approach primarily where a more comprehensive suite of policies and programs is required to achieve significant energy and emissions reductions, such as the programs, policies, regulations, and incentives required to drive the market transformation necessary to improve the performance of existing buildings. Some of these actions are not readily quantifiable, but are critical to enabling the District's success nonetheless. In this way, the team used the model as an analysis and engagement tool to foster a common understanding of what it will take the District to achieve its targets. The District Government has been given a copy of the model and, going forward, can use it to evaluate whether the District is on track to meet its targets. The methodology for calculating greenhouse gas emissions in this document aligns with the District's own regular GHG Inventories. Emissions are measured and reported according to leading national and international greenhouse gas reporting protocols, and follows guidance from ICLEI – Local Governments for Sustainability, C40 Cities Climate Leadership, and the World Resources Institute.

The model is not intended to be a predictive tool and does not account for costs or externalities other than GHG emissions. The intent of the Plan is to provide the District with a roadmap to achieving its 2032 GHG reduction target, the most achievable and arguably most important of its 2032 targets, while leading the District in the direction of achieving their energy use reduction and renewable energy goals. The Plan provides this roadmap through a package of policy and program recommendations, with additional information and recommendations regarding the design and implementation of such actions based on available research and experiences in other leading jurisdictions. The specific design and implementation of many of these actions will take further analysis, including understanding the potential cost-effectiveness and relative feasibility of program and policy approaches and designs. This analysis, design, and implementation work (some of which is underway, see section 1.8) will be conducted in coordination with District stakeholders, many of whom are identified in the Plan.

A1.2 MODEL ASSUMPTIONS AND DATA SOURCES

The team used the model to project a business-as-usual (BAU) estimate for energy consumption and GHG emissions based on assumed developments and activity in energy supply, buildings, and transportation. The team then simulated actions in each of these areas to develop a set of policy scenarios, resulting in a set of actions that reduce GHG emissions, reduce energy consumption, and increase renewable energy, as presented in section 2.2.2. The sections below summarize the assumptions behind the BAU projection and policy scenario.

A1.2.1 BUILDINGS

Energy and emissions in the building sector are based on square footages, energy use intensities (EUI), and fuel mixes. The sector is split into a set of building types to align with how buildings are categorized in District Government data sources, account for differences in energy consumption characteristics, and allow users of the model to target specific actions to different building types.

A1.2.1.1 BUSINESS-AS-USUAL ASSUMPTIONS

Building square footage changes as a result of changes in the building stock due to new construction, demolitions, and building rehabs. Table A1 summarizes the square footages for each building type in 2015, as well as growth assumptions for each modeled building type. Building square footages were extracted from the District Government's Office of Tax and Revenue's Computer Assisted Mass Appraisal Database (CAMA). Annual construction rates are based on data maintained by the Office of Planning. *New square footage growth* rates represent annual net growth in square footage in the District that results either from developing on undeveloped sites or redeveloping sites with a net increase in square footage. These rates are based on employment, household, and population projections for 2010 to 2045. *Square footage replacement* rates represent new construction that results in new square footage that replaces old square footage. This involves removing square footage associated with an older building (from the existing building stock), typically with a poorer energy performance, and replacing it with square footage at an energy performance based on latest building code. These rates are based on the 2010 to 2045 projections referenced above, as well as the breakdown of development types (e.g., new construction, demolition, renovation, and rehab) tracked in the Office of Planning's Development Activity Database (as of October 2015).

Building energy and emissions are driven by square footage, energy use intensities (EUI), fuel mix, and fuel GHG intensities. Table A2 summarizes the estimated EUI and energy consumption by fuel type for each building type in 2015. Site energy use was chosen because changes in site energy use can most easily be affected by local policies and quantified in the model, and because generation losses, transmission losses, and fugitive emissions are accounted for through the GHG calculations (discussed in further detail below). Each building type's EUI was determined through a combined bottom-up top-down approach using multiple data sources. The purpose of the approach is to calculate total energy consumption by fuel type using square footage and EUIs (bottom-up) so that it matches estimated total energy consumption for buildings in the District (top-down). Total energy consumption by fuel type was sourced from 2013 data from Pepco via DOEE in January 2016. More recent accurate building energy consumption data was not available at the time the model was populated. The team determined EUIs first from 2014's Private Building Benchmarking Dataset as cleaned by the

Center for Urban Science and Progress at New York University.⁴³⁶ Where additional data was needed to match the bottom-up and top-down figures, the team sourced data from nearby states (preferably in the same climate zone as designated by the Commercial Buildings Energy Consumption Survey), then from national sources as needed (primarily data from the 2012 Commercial Buildings Energy Consumption Survey). Single-family residential energy data is not included in these sources, so was sourced from data used for a previous iteration of the Plan.

	Gross Square Footage in 2015	Annual Construction Rates	
		New Gross Square Footage Growth	Gross Square Footage Replacement
Residential	358,205,024	-	-
Single Family Dwellings and Small Multifamily	186,532,207	0.20%	0.09%
Medium and Large Multifamily	171,672,817	1.05%	0.45%
Institutional and Government	151,582,127	-	-
Education and Other Institutional	31,620,942	0.78%	0.33%
Federal Government	81,398,472	0.00%	0.00%
Municipal Government	29,720,568	0.00%	0.00%
Embassy	8,842,145	0.00%	0.00%
Commercial and Industrial	249,205,839	-	-
Office	171,578,263	0.97%	0.42%
Hotel	23,543,628	0.78%	0.33%
Other Commercial and Industrial	47,463,319	0.78%	0.33%
Hospital and other Medical	6,620,629	0.78%	0.33%
Total	758,992,990	-	-

↑ **Table A1.** Summary of building stock square footage and growth and development assumptions

**Includes buildings designated under the District of Columbia Housing Authority.*

⁴³⁶ Benchmarking and Data Quality Analysis of Energy Disclosure Data for Washington, DC, October 28, 2015.

A1.2.1.2 BUILDING CODE ASSUMPTIONS

The model uses building codes to affect the energy performance of new and rehabilitated buildings. Two sets of building codes are applied: one targeting single-family and small multifamily buildings (residential buildings under 10,000 ft²) and another targeting commercial and large multifamily buildings. Both codes are updated for 2018, 2020, and 2026. Current codes are based on ASHRAE 2013 and no new construction includes fuel oil. For single-family and small multifamily buildings, the impact of new codes is felt two years after code adoption (e.g., code adopted in 2017 impacts energy use of new buildings in 2019). For commercial and large multifamily buildings, the impact of new codes is felt three years after code adoption (e.g., code adopted in 2017 impacts energy use of new buildings in 2020). Each code adoption impacts building energy performance by reducing the EUI of the building type. The code adoption cycle is summarized in Table A3.

	Site Energy Use Intensities (EUI) in 2015 (kBtu/ft2)				Estimated Site Energy Consumption in 2015 (million kBtu)			
	Total	Electricity	Natural Gas	Fuel Oil	Total	Electricity	Natural Gas	Fuel Oil
Residential					24,352	7,866	14,955	1,530
Single Family Dwellings and Small Multifamily	51.4	9.50	36.0	5.9	9,588	1,772	6,715	1,101
Medium and Large Multifamily	86.0	35.5	48.0	2.5	14,764	6,094	8,240	429
Institutional and Government					16,289	9,742	6,467	80
Education and Other Institutional	104.0	61.5	42.0	0.5	3,289	1,945	1,328	16
Federal Government	109.5	65.0	44.0	0.5	8,913	5,291	3,582	41
Municipal Government	104.5	65.0	39.0	0.5	3,106	1,932	1,159	15
Embassy	111.0	65.0	45.0	1.0	981	575	398	9
Commercial and Industrial					24,618	18,148	6,259	212
Office	89.5	76.5	12.5	0.5	15,356	13,126	2,145	86
Hotel	105.5	59.0	46.0	0.5	2,484	1,389	1,083	12
Other Commercial and Industrial	114.5	54.5	58.0	2.0	5,435	2,587	2,753	95
Hospital and other Medical	203.0	158.0	42.0	3.0	1,344	1,046	278	20
Facilities Excluded from Analyses*					1,262	700	562	0
DC Water	n/a	n/a	n/a	n/a	762	700	62	0
GSA Central Heating Plant	n/a	n/a	n/a	n/a	500	n/a	500**	0
Total					66,521	36,456	28,243	1,822
Total Site Energy Use from DOE					66,849	36,637	28,380	1,829
Total Missing Site Energy Use					325	181	137	7
Percent Missing Site Energy Use					0.5%	0.5%	0.5%	0.45%

↑ **Table A2.** Summary of building energy use

**These facilities are not included in policy simulations because the Plan assumes building actions do not affect their performance.

**Natural gas use at the GSA Central Heating Plant includes only natural gas consumed in the process of generating steam for Federal Government buildings, so as to avoid double counting GHG emissions captured by these buildings' energy consumption.

Adoption Year	Single-Family and Small Multifamily Buildings	Commercial and Large Multifamily Buildings
Current	Based on EUIs for 2012's International Energy Conservation Code ⁴³⁷	
2018	High-performance code update with EUIs 35-65% lower than the average existing building, depending on building type ⁴³⁸	
2020	Net-zero code adopted, the majority of building energy is shifted to electricity based on a breakdown of fuel consumption by end use and the relative energy efficiencies of HVAC, DHW, and other technologies ⁴³⁹	High-performance code update with deeper EUI reductions that vary by building type
2026		Net-zero code adopted ⁴⁴⁰

↑ **Table A3.** Assumed code adoption cycle

***These facilities are not included in policy simulations because the Plan assumes building actions do not affect their performance. **Natural gas use at the GSA Central Heating Plant includes only natural gas consumed in the process of generating steam for Federal Government buildings, so as to avoid double counting GHG emissions captured by these buildings' energy consumption.*

The high-performance code update for commercial and large multifamily buildings is assumed to get new buildings approximately halfway between the EUI required under the 2018 code update and the net-zero codes adopted in 2026. Buildings constructed under net-zero codes are assumed to have EUIs that would allow the building to be supplied with on-site energy (approximately 75-80% lower than average existing buildings in the District). However, the specific EUI and fuel source requirements will vary by building type and size, as well as other characteristics, and the EUIs used in the model should not be seen as a "net-zero level EUI" for purposes beyond this broad modeling exercise. DOE is able to update these assumptions as net-zero energy codes are further researched and developed. Further, any renewable energy associated with these buildings is assumed to be covered by the RPS local solar requirements, so additional renewable energy is not added to the model. The model assumes code compliance of 85% for all codes except the first three years of net-zero codes, which have compliance rates of 70%, 75%, and 80%, respectively.⁴⁴¹ Based on the structure of the model, an 85% code compliance rate means the District achieves 100% of the code's energy and GHG reduction potential from 85% of the affected building square footage, and no energy use or GHG reduction from the remaining 15%. In reality, the 15% non-compliant buildings would very likely still achieve some energy use and GHG reduction from partial code compliance. This means the GHG reductions attributed to new construction may be slightly underestimated.

⁴³⁷ Pacific Northwest National Laboratory, 2013, Energy and Energy Cost Savings Analysis of the IECC for Commercial Buildings <https://www.energycodes.gov/sites/default/files/documents/PNNL-22760.pdf>

⁴³⁸ Informed by Pacific Northwest National Laboratory, December 2017, Energy Savings Analysis of the Proposed Revisions of the Washington, D.C. Non-Residential Energy Code, as well as correspondence with DOE staff on September 21, 2016.

⁴³⁹ Data sources for fuel switching calculations based on a compilation of data sources noted in the model, including from the Energy Information Administration's RECS 2009 and CBECS 2012 survey results and the Northeast Energy Efficiency Partnerships' Northeast/Mid-Atlantic Air-Source Heat Pump Market Strategies Report (2014) and associated air-source heat pump database (2017).

⁴⁴⁰ Ibid.

⁴⁴¹ Recall, compliance targets are typically set at 90% because the 2009 American Recovery and Reinvestment Act (ARRA) legislation required states to develop plans to achieve 90% compliance with the energy codes by 2017 in order to receive energy funding.

A1.2.1.3 EXISTING BUILDING ASSUMPTIONS

The model uses ongoing programs offered by the DCSEU, retrofits, a building energy performance standard (BEPS), and gut rehabs to reduce energy and emissions from existing buildings. The DCSEU is assumed to achieve energy use reductions a bit higher than the Utility's minimum performance targets for energy use reduction, based on improving trends of annual energy use reductions by the DCSEU.⁴⁴² These reductions are assumed over the current five-year contract between the District Government and the DCSEU, after which the model shifts towards deeper retrofits, which would be implemented by the DCSEU alongside other organizations, like the proposed Green Bank.

The retrofits assumed in the model are intended to provide the District a sense of the scale of action required in the existing building sector to achieve their 2032 GHG reduction target, while being realistic enough to achieve and sustain for over a decade. The scale of retrofits assumed for private buildings is equivalent to achieving a 40% energy use reduction across 2% of the building stock each year from 2022 through 2032 (or a lower average energy use reduction across a larger portion of existing buildings, etc.). The term retrofits in this regard is a bit of a misnomer; in reality, the modeled retrofits will include a variety of building interventions focused on reducing energy and/or emissions, ranging from lighting upgrades to full envelope and HVAC system replacements. Put another way, the combined actions on existing buildings requires the District to reduce energy use in buildings by approximately 0.75-1% of BAU building energy per year (or higher if accounting for energy use reductions from previous years).

(It is important to note how the building assumptions in this Plan compare to the 2013 report prepared for DOEE, *Electric and Natural Gas Energy Efficiency and Demand Response Potential for the District of Columbia*. Readers of that study may note that the energy use reductions deemed realistically achievable in this Plan are lower than those in the *Potential* study. This is due to differences in the purpose and methodology of the two pieces of work. In short, the purpose of the *Potential* study was to identify and characterize opportunities to improve energy performance in building across the District using a methodology common among utilities that estimates the technical, economic, and achievable potential for energy use reductions, considering the full economic benefits of energy efficiency work to society. It was also based on national and regional assumptions combined with a high-level understanding of the building stock in 2013, prior to the systematic collection of building-level energy benchmarking data. The primary purpose of *Clean Energy DC* is to provide the District with a full plan and phased roadmap to achieve its overall energy and emissions targets, considering the overall state of energy and emissions in the District, the District Government's current set of plans, policies, and programs alongside an understanding of their historical and current performance, and the resources the District Government has to dedicate to the implementation of the Plan over the next several years. As a result, the *Clean Energy DC* team's existing building assumptions focused more on overall program limitations, and the development of the Plan sought the most realistic set of actions to achieve the District's 2032 targets across buildings, transportation, and energy supply. For the existing building assumptions in particular, this involved reviewing existing and planned programs in other jurisdictions, checking assumptions with experts in existing building energy performance programs, and engagement with knowledgeable District Government staff and external stakeholders. The final result is that the Plan finds a path to exceed the District's GHG reduction target with lower building energy reductions that found to be achievable in the *Potential* study. Neither study should be seen as in conflict with the other. The Plan provides the District an overall roadmap to achieve the 2032 GHG target. The *Potential* study, which provides more specific information on the energy reduction potential of different in-building changes, will continue to be valuable to those designing, developing,

⁴⁴² Breakdown of targets and projected performance provided by the DCSEU on December 1, 2017

resourcing, and implementing existing building programs on-the-ground. It is the *Clean Energy DC* team's intent that the two separate pieces of work be used together as the District moves forward.)

The model assumes the District Government implements a more aggressive retrofit program, as summarized in Table A4. The program involves deeper energy use reductions sooner and across a higher portion of the building stock. Again, the actual portion of square footage that needs to be retrofitted will depend on the depth of the average energy use reduction (deeper average reductions mean less of the building stock needs to be retrofitted and vice versa). The retrofits are intended to improve performance, as well as provide leadership and demonstrate building energy efficiency capabilities to the private sector (for deep energy retrofits and net-zero codes). The model assumes the Federal Government retrofits 20% as much square footage as the District Government at the same average energy use reduction. The model does not assume that any embassy buildings are retrofitted.

Years	Annual Square Footage Affected by Retrofits	Average Energy Use Reduction
2021	1.50%	30%
2022	2.00%	30%
2023	2.50%	30%
2024	3.00%	30%
2026 and 2027	1.00%	80%
2028 through 2030	1.50%	80%
2031 through 2032	3.00%	80%

↑ **Table A4.** Retrofit assumptions for District Government buildings

Two other actions are captured in existing buildings that drive down energy consumption and GHG emissions. First, the model includes a building energy performance standard (BEPS). BEPS covers all buildings required to comply with the District's benchmarking requirements and requires the worst performing buildings (for each building type) to improve their energy performance every five years. The energy use reductions included in the model are based on modeling done in support of a BEPS analysis focused on determining how best to design BEPS for the District. The model uses the midpoint energy use reduction estimate of two potential BEPS designs. Both designs require buildings triggering BEPS to improve their performance through a suite of mandatory improvements and either an Improvement Path (requiring a 15 point increase in ENERGY STAR Score) or a Prescriptive Path (requiring retrocommissioning, an energy audit, and action on items with a payback less than three years). The difference between the two designs is the threshold of buildings that trigger and are required to comply with BEPS: the bottom 20th percentile or the bottom 40th percentile of buildings in each building category based on ENERGY STAR Score. This is not the final proposed design recommendation for BEPS; design options have been made to the District separately and Action EB.5 summarizes the key considerations. The resulting penetration rates and average energy use reductions used in the model are summarized in Table A5. The data used to generate these values was taken from 2014's Private Building Benchmarking Dataset.

Building Type*	Percent of Total Square Footage Affected by BEPS (between 2020 and 2032)	Average Energy Use Reduction
Multifamily (5+ units)	19.60%	13.30%
Education and Other Inst'l (non-gov.)	40.30%	14.60%
Office	21.50%	13.60%
Hotel	35.00%	15.10%
Other Comm. and Industrial	6.80%**	15.70%
Hospital and Other Medical	5.80%**	10.90%

↑ **Table A5.** Summary of energy use reduction and penetration inputs used to represent BEPS

*District government buildings are also subject to BEPS and are captured in the other building types.

**The small percentage of Other Comm. and Industrial (n=27) and Hospital and Other Medical (n=6) buildings triggering BEPS results from the low number of buildings covered by the 2014 benchmarking dataset and the approach of capturing the worst performing buildings based on their relative performance.

Second, the model assumes that a portion of existing buildings go through a rehab each year, triggering the requirement to comply with the most recent building codes for the portion of the building undergoing a rehab. The portion of buildings undergoing a rehab each year is based on the Office of Planning's Development Activity Database (updated October 2015), which tracks buildings (but not square footage) undergoing development each year (e.g., new construction, demolition, renovation, rehab). Given that the Development Activity Database does not track exactly what portion of each building undergoing a rehab, and thus the aspects of the building triggering code compliance are unknown, representatives from DOEE and the consultant team agreed to assume that the rehabs result in the average building improving their energy performance by half as much as if the entire building was required to meet the latest code.

A1.2.2 ENERGY SUPPLY

GHG intensity factors are applied to energy use by fuel type to calculate total GHG emissions. The GHG intensity of electricity accounts for losses from generation and transmission. The model uses the RFC-East sub-region factor from the EPA's eGRID database of regional GHG intensities.⁴⁴³ The GHG intensity of natural gas includes fugitive emissions from transmission and distribution.

The GHG intensity (tCO₂e/kBtu) of all energy types stays constant in the BAU scenario (Table A6) including electricity. This was done to capture and communicate about the impact of the District's existing Renewable Portfolio Standard (RPS) requirements. The model does not assume additional declines due to the federal regulation or electricity generation plant closures and replacements. The implementation of and compliance strategies in response to the CPP, as well as other plant closures, will have an uncertain impact on the District that is likely to overlap with emissions reductions achieved through the RPS (as states and suppliers look for the most cost-effective approaches to complying with both regulations). As such, to avoid overly optimistic assumptions about declining electricity emissions, these external forces were assumed not to

⁴⁴³ The RFC-East eGRID subregion includes the District of Columbia, Delaware, New Jersey, and portions of Maryland and Pennsylvania, <https://www.epa.gov/energy/egrid>

decrease the electricity emissions factor. This means deeper emissions reductions from changes in electricity supply are very likely to occur by 2032 than is modeled for the Plan's BAU scenario. If the GHG intensity of the electricity grid declines due to such external forces, such as a shift from coal to natural gas, it will reduce the GHG reductions attributed to actions in the Plan, but ultimately should lead to lower GHG emissions.

Energy Type	BAU GHG Emissions Factor (tCO ₂ e/kBtu)	Notes for Policy Scenarios
Electricity	0.000116 ⁴⁴⁴	Declines due to energy supply policies in the policy scenario.
Natural Gas	0.000055 ⁴⁴⁵	
Fuel Oil	0.000074 ⁴⁴⁶	
Gasoline	0.000074 ⁴⁴⁷	Stays constant in all scenarios
Diesel	0.000074 tCO ₂ e/kBtu ⁴⁴⁸	

↑ **Table A6.** GHG emissions factors for energy types in BAU simulations

A1.2.2.1 EXISTING BUILDING ASSUMPTIONS

Two energy supply policies target the GHG emissions intensity of electricity. The first is the District's increasing RPS. The RPS has a local solar requirement as well as overall renewable energy requirements. As described in the Plan, suppliers can comply with either portion of the RPS either by acquiring renewable energy certificates (RECs) or paying alternative compliance payments (ACPs) where RECs are unavailable to more costly than ACPs. All ACPs are used to fund local solar projects, so the model assumes that the District ultimately achieves the entire local solar portion of the RPS. As explained in section 2.2.1.2, the requirements of the GHG accounting protocol used by the District, in combination with the compliance options offered by the RPS, mean it is very unlikely that the full potential of GHG reductions possible under the remainder of the RPS will be captured by the District.⁴⁴⁹ Therefore, the actual decline in the District's electricity GHG emission factor is uncertain and depends on RPS compliance. As such, representatives from DOEE and the consultant team decided to assume 57% of the potential GHG emissions reductions that may be achieved under the non-local portion of the RPS are captured by the District, while the remainder of the RPS is complied with using ACPs or RECs that do not affect the GHG emissions intensity of electricity in the District.⁴⁵⁰ In reality, the GHG reductions that may be triggered by and attributable to the RPS could be higher or lower than this, as discussed in the Plan.

⁴⁴⁴ The U.S. Environmental Protection Agency's eGRID factor for RFC-East subregion for 2014, updated on February 27, 2017 (accessed August 2, 2017). https://www.epa.gov/sites/production/files/2017-02/documents/egrid2014_summarytables_v2.pdf

⁴⁴⁵ Sourced from ICLEI with fugitive emissions added. ICLEI source: Table B.1, Appendix C, ICLEI U.S. Community Protocol V1.1, <http://icleiusa.org/publications/us-community-protocol/>

⁴⁴⁶ Table B.1, Appendix C, ICLEI U.S. Community Protocol V1.1, <http://icleiusa.org/publications/us-community-protocol/>

⁴⁴⁷ Calculated from 2012 and 2013 transportation demand, energy consumption and GHG emissions data provided to DOEE by the Metropolitan Washington Council of Governments, which is also used for the District's GHG inventory.

⁴⁴⁸ Ibid.

⁴⁴⁹ The District uses ICLEI's U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions (Community Protocol).

⁴⁵⁰ Based on the finding that 57% of all non-hydroelectric renewable energy capacity built in the United States from 2000 to 2015 is being used to meeting RPS requirements. Finding sourced from Barbose, Galen. 2016. "U.S. Renewables Portfolio Standards: 2016 Annual Status Update." Lawrence Berkeley National Laboratory. <https://emp.lbl.gov/sites/all/files/lbnl-1005057.pdf>

The second policy is supplying the District's standard offer service (SOS) through a renewable energy power purchase agreement (PPA). Approximately 24% of the electricity supplied to the District is sold through the SOS.⁴⁵¹ The policy scenario assumes that the full PPA can be supplied by a set of renewable energy PPAs with an average of 70% of the electricity supplied by renewable energy and the remainder from the spot market (the spot market uses the average electricity GHG emissions intensity for that year). To be conservative, the model assumes 10% of customers opt-out after the switch to the renewable energy PPA, reducing the portion of electricity consumption served by the SOS to 21.6%. Actual customer retention or loss is uncertain at this time and could be higher or lower than the assumption above. It is likely that if a lower electricity rate can be secured, more customers may shift to the SOS than are currently supplied by it, thereby increasing the GHG reductions achieved by this action. SOS adoption may also increase due to a desire by electricity customers to be supplied by renewable and/or zero emission energy.

Table A7 summarizes the assumed GHG intensity of electricity until 2032 when the above policies are implemented. The actual GHG intensity of the grid, as experienced by the District, between now and 2032 will depend on multiple factors, including compliance with the RPS, what can be achieved by the PPA for SOS, and external factors that affect the regional electricity grid (e.g., market forces, federal regulatory impacts).

Year	2017	2018	2019	2020	2021	2022	2023	2024
GHG Intensity	0.000106	0.000105	0.000101	0.000097	0.000094	0.000094	0.000094	0.000092
Year	2025	2026	2027	2028	2029	2030	2031	2032
GHG Intensity	0.000090	0.000088	0.000086	0.000084	0.000082	0.000080	0.000078	0.000076

↑ **Table A7.** Estimated GHG intensity of electricity (tCO₂e/kBtu) under the policy scenario

A1.2.2.2 NEW DISTRICT ENERGY SYSTEMS

Finally, the energy supply is affected by installations of new district energy systems, referred to as neighborhood-scale energy systems in the Plan. The model includes two assumed sets of new district energy systems. First, the District is able to capture 20% of the wastewater thermal supply identified by DC Water by 2032, totaling 37 MW of supply at a capacity factor of 47.4%.⁴⁵² The district energy systems are assumed to supply buildings with zero-emission baseload energy to meet 67% of demand, with peaking natural gas providing the remaining 33%. Second, two natural gas-fired combined heat and power systems are installed at the Walter Reed and St. Elizabeth's sites currently under development. The annual GHG reduction potential from these sites is initially 7,000 and 14,000 tCO₂e, respectively, and then declines as the GHG intensity of electricity declines.⁴⁵³

⁴⁵¹ Correspondence with DOEE representatives on August 1, 2016.

⁴⁵² DC ENERGIZED, DC Water's Energy Opportunities, DRAFT 2-11-2016.

⁴⁵³ GHG reduction potential provided by Urban Ingenuity on September 20, 2016.

A1.2.3 TRANSPORTATION

A1.2.3.1 TRANSPORTATION DEMAND AND MODE SHARE

In addition to growth in the building stock, the model assumes growth in transportation demand and associated energy and GHG emissions. BAU transportation demand and mode share are based on recent transportation data from the Metropolitan Washington Council of Governments (MWCOCG) as well as the District's Multimodal Long-Range Transportation Plan *moveDC*.⁴⁵⁴ *moveDC* forecasts total transportation demand and mode share out to 2040 in a BAU scenario,⁴⁵⁵ which is translated into VMT demand by mode share (passenger vehicle, transit, cycling and walking) out to 2032. BAU mode share in 2032 is 55% passenger vehicle, 24% transit, and 19% cycling. For the policy scenario, the consultant team assumed the same total VMT demand but shifted demand from passenger vehicles to transit, cycling and walking based on the District's mode share target in the *Sustainable DC Plan*.⁴⁵⁶

The model captures energy consumption and GHG emissions from the Metrorail (metro), transit buses, and other medium and heavy duty vehicles based on the aforementioned MWCOCG transportation data provided to DOEE. Energy and emissions from on-road transit vehicles (buses) and metro transit grow with increasing transit demand, which is driven by the changes in mode share discussed above. For metro transit, the model assumes that metro energy consumption grows at 30% the rate of metro demand growth.⁴⁵⁷ The GHG emissions associated with metro transit are then affected by the changes in the GHG intensity of electricity. Transit buses are discussed further in section A1.2.3.3. Energy consumption by medium and heavy duty vehicles is assumed to grow at the same rate as passenger vehicle demand in the BAU scenario. No policies target these vehicles because this was out of scope.

A1.2.3.2 VEHICLE ASSUMPTIONS AND POLICIES

As the passenger vehicle stock grows, existing vehicles in the stock are retired and new vehicles are purchased each year. As a result, the average fuel efficiency of the vehicle stock and the vehicles that comprise it change. Each year, 6.67% of the existing passenger vehicle stock is replaced by new vehicles.⁴⁵⁸ New vehicles entering the stock have a higher fuel efficiency rating due to the federal Corporate Average Fuel Economy (CAFE) Standard, which results in the average fuel efficiency of the entire stock declining.⁴⁵⁹ The GHG and energy use reduction impacts of the CAFE Standard were included in the policy scenario wedge diagrams to make its impact explicit to readers. Because it is a federal regulation already in place, the CAFE Standard will achieve GHG reductions regardless of action taken by the District, but the level of its impact changes based on the mode share changes achieved by the District.

⁴⁵⁴ Based on all vehicle miles traveled in the District, regardless of origin or destination. Recent transportation data comes from 2012 and 2013 transportation demand and mode share data provided to DOEE by the Metropolitan Washington Council of Governments, which is also used for the District's GHG inventory. *moveDC*, <http://www.wemoveDC.org/index2.html>

⁴⁵⁵ Table V.3 in *Move DC* Vehicle section, p.31.

⁴⁵⁶ 50% of commuter trips from public transit, 25% from biking and walking, and 25% by car or taxi. *Sustainable DC Plan*, p.12

⁴⁵⁷ This is calculated based on relative GHG emissions factors (between electricity and gasoline and diesel) the Washington Metropolitan Area Transit Authority's 2015 sustainability report, which states that switching from driving to metro results in approximately a 50% GHG reduction. WMATA Sustainability Report 2015, p.7, <https://www.wmata.com/initiatives/sustainability/upload/2017-Annual-Sustainability-Report.pdf>

⁴⁵⁸ Based on the number of new vehicle sales vs. the number of total registered vehicles in the United States over the past several years. This assumption means vehicles in the model last for 15 years, whereas the NHTSA has found that the average life on the road is about 11.5 years (<https://www.statista.com/statistics/185198/age-of-us-automobiles-and-trucks-since-1990/>), with approximately 70% of vehicles on the road after 15 years, and some longer (<http://www-nrd.nhtsa.dot.gov/Pubs/809952.pdf>). Total registered vehicles in 2015 - <https://www.statista.com/statistics/183505/number-of-vehicles-in-the-united-states-since-1990/>. Light vehicle retail sales: <https://www.statista.com/statistics/199983/us-vehicle-sales-since-1951/>

⁴⁵⁹ CAFE Standard fuel efficiency values are based on modeling down to support the U.S. Energy Information Administration's Annual Energy Outlook 2015.

Electric vehicle (EV) adoption is also assumed to increase over the model time period. The model includes battery electric vehicles, which are powered entirely by electricity from the grid, and plug-in hybrid electric vehicles, which are initially powered by a battery, then a petroleum fuel-based engine when the battery is depleted.⁴⁶⁰ The consultant team assumed EV market share for new vehicles (the share of new vehicles sold that are electric vehicles) reaches 30% by 2030, and 38% by 2032. This requires effective policies and programs focused on EV readiness and adoption, and is in line with the levels of adoption found necessary for California to achieve its 2050 GHG reduction target of 80% below 1990 levels.⁴⁶¹ The model assumes the mix of battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs) starts at 50/50, and steadily shifts towards BEVs with 60% of EV sales in 2030 and 72% in 2032. This reflects the anticipated to purely electric vehicles (BEVs) as EV technology improves and consumers become more comfortable with EVs.

A1.2.3.3 FULL TRANSIT BUS EMISSIONS FORECAST RESULTS

The following five future transit bus fleet scenarios were forecasted through 2032 to assess the emissions reductions possible through the use of different bus propulsion types. The first scenario reflects the currently planned future bus purchases by WMATA and DDOT; this scenario served as the baseline for the analysis. The other four scenarios reflect future bus fleets in which all buses purchased through 2032 are of a single vehicle propulsion type.

- Scenario 1: Fleets As Currently Planned (baseline)
- Scenario 2: Clean Diesel
- Scenario 3: Diesel/Electric Hybrid
- Scenario 4: Compressed Natural Gas (CNG)
- Scenario 5: Electric

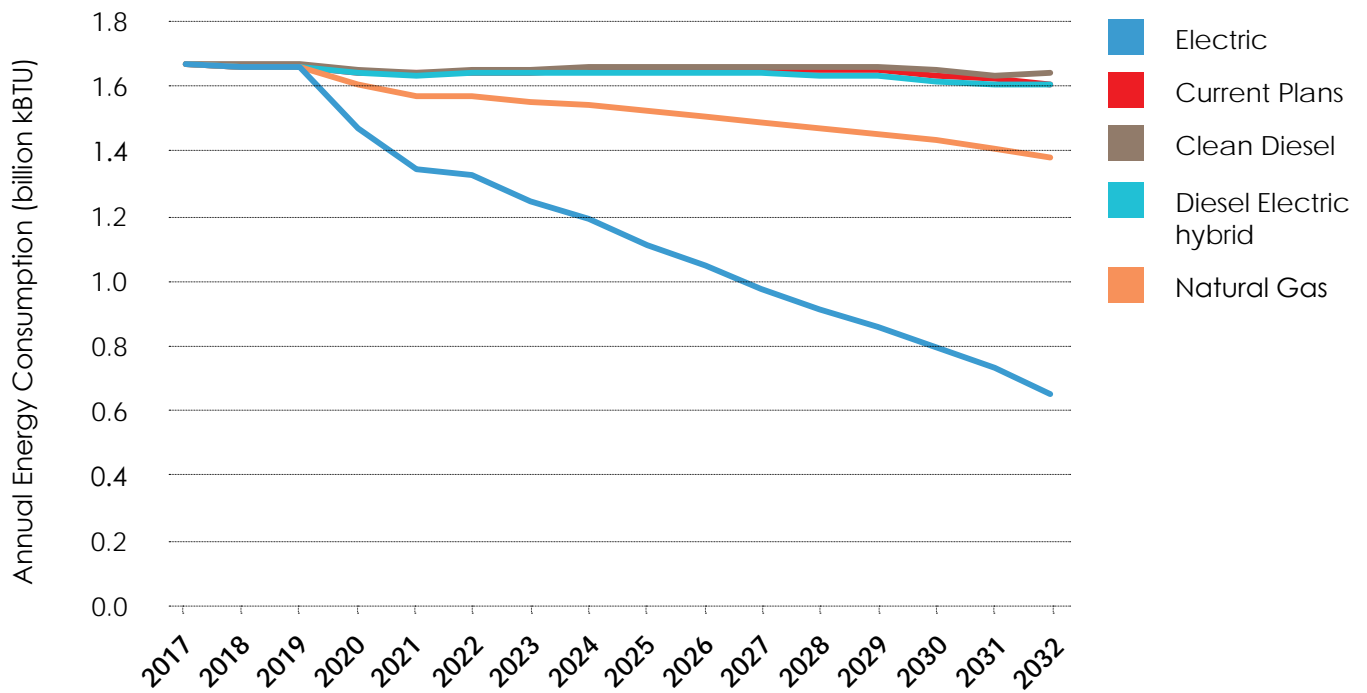
The following charts display forecasts of energy consumption, GHG emissions, and criteria air pollutant emissions based on these scenarios, and Table A8 summarizes the 2032 results compared to 2017. Note that these values assume BAU mode share and scale of reductions achieved in any scenario increases as more share increases under the policy scenario.

⁴⁶⁰ The model assumes plug-in hybrid electric vehicles operate on electricity 66% of the time and gasoline 34% of the time. Based on Marshall, B.M., Kelly, J.C., Lee, T.-K., Keoleian, G.A., Filipi, Z., 2013. Environmental assessment of plug-in hybrid electric vehicles using naturalistic drive cycles and vehicle travel patterns: A Michigan case study. *Energy Policy* 58, 358–370; Kelly, J.C., MacDonald, J.S., Keoleian, G. a., 2012. Time-dependent plug-in hybrid electric vehicle charging based on national driving patterns and demographics. *Appl. Energy* 94, 395–405.

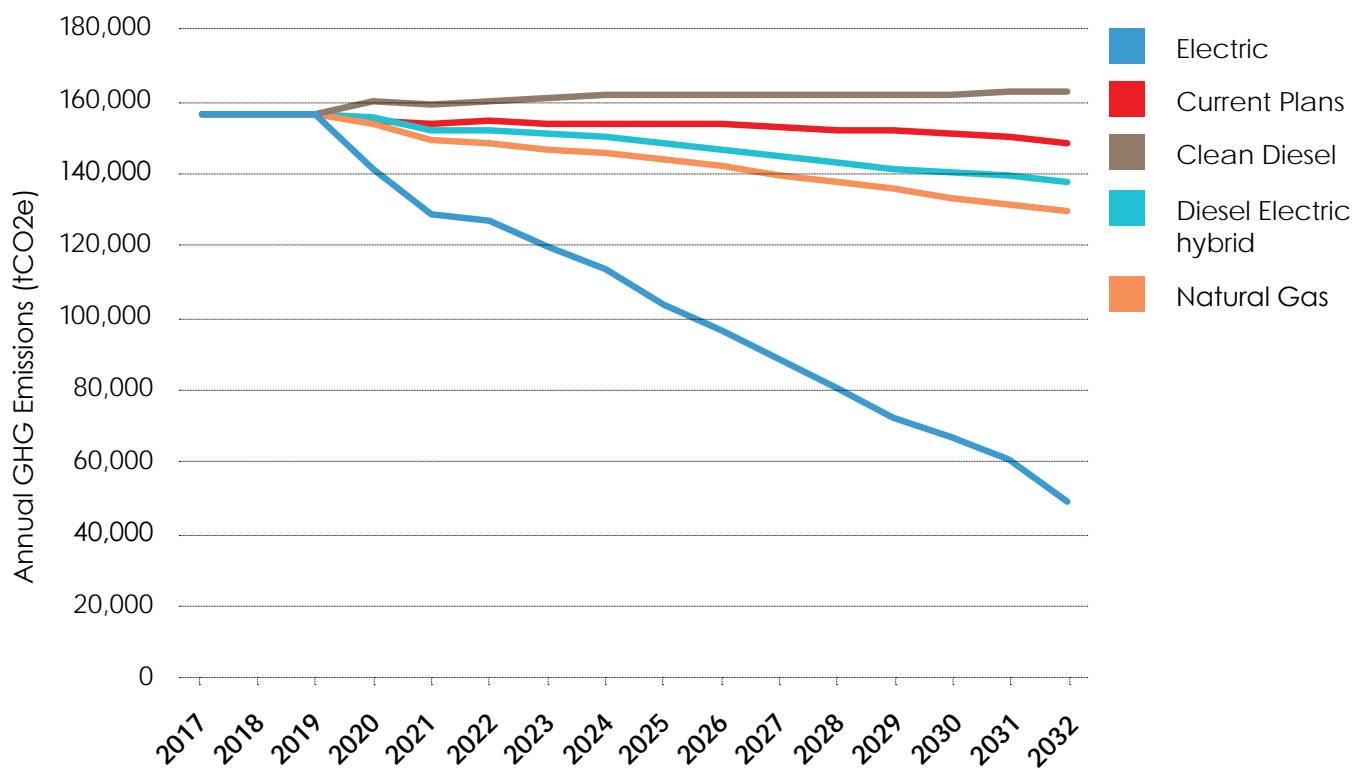
⁴⁶¹ e.g., Greenblatt, J.B., 2015. Modeling California policy impacts on greenhouse gas emissions. *Energy Policy* 78, 158–172; Greene, D.L., Park, S., Liu, C., 2014a. Public policy and the transition to electric drive vehicles in the U.S.: The role of the zero emission vehicles mandates. *Energy Strateg. Rev.* 5, 66–77; Greene, D.L., Park, S., Liu, C., 2014b. Analyzing the transition to electric drive vehicles in the U.S. *Futures* 58, 34–52; Wei, M., Nelson, J.H., Greenblatt, J.B., Mileva, A., Johnston, J., Ting, M., Yang, C., Jones, C., McMahon, J.E., Kammen, D.M., 2013. Deep carbon reductions in California require electrification and integration across economic sectors. *Environ. Res. Lett.* 8, 014038; Yang, C., Yeh, S., Zakerinia, S., Ramea, K., McCollum, D., 2015. Achieving California's 80% greenhouse gas reduction target in 2050: Technology, policy and scenario analysis using CA-TIMES energy economic systems model. *Energy Policy* 77, 118–130.

Metric (unit)	2017 Value	Projected 2032 Values, by Scenario					Associated Figure
	All Scenarios	1	2	3	4	5	
Energy Consumption (million kBtu)	1,666	1,606	1,638	1,385	1,606	650	
GHGs (tCO ₂ e)	156,163	148,390	163,011	137,888	129,996	49,396	
Carbon Monoxide (lbs. CO)	146,049	234,584	63,610	31,713	510,275	229	
Nitrous Oxide (lbs. N ₂ O)	98,021	89,464	141,094	140,317	9,039	1,043	
Coarse Particulate Matter (lbs. PM ₁₀)	2,445	1,951	2,971	2,955	357	22	
Fine Particulate Matter (lbs. PM _{2.5})	2,171	1,697	2,615	2,597	269	20	
Volatile Organic Compounds (lbs. VOC)	8,061	8,234	6,084	6,068	11,530	42	
Sulphur Oxide (lbs. SO _x)	1,681	1,554	1,967	1,663	957	11	

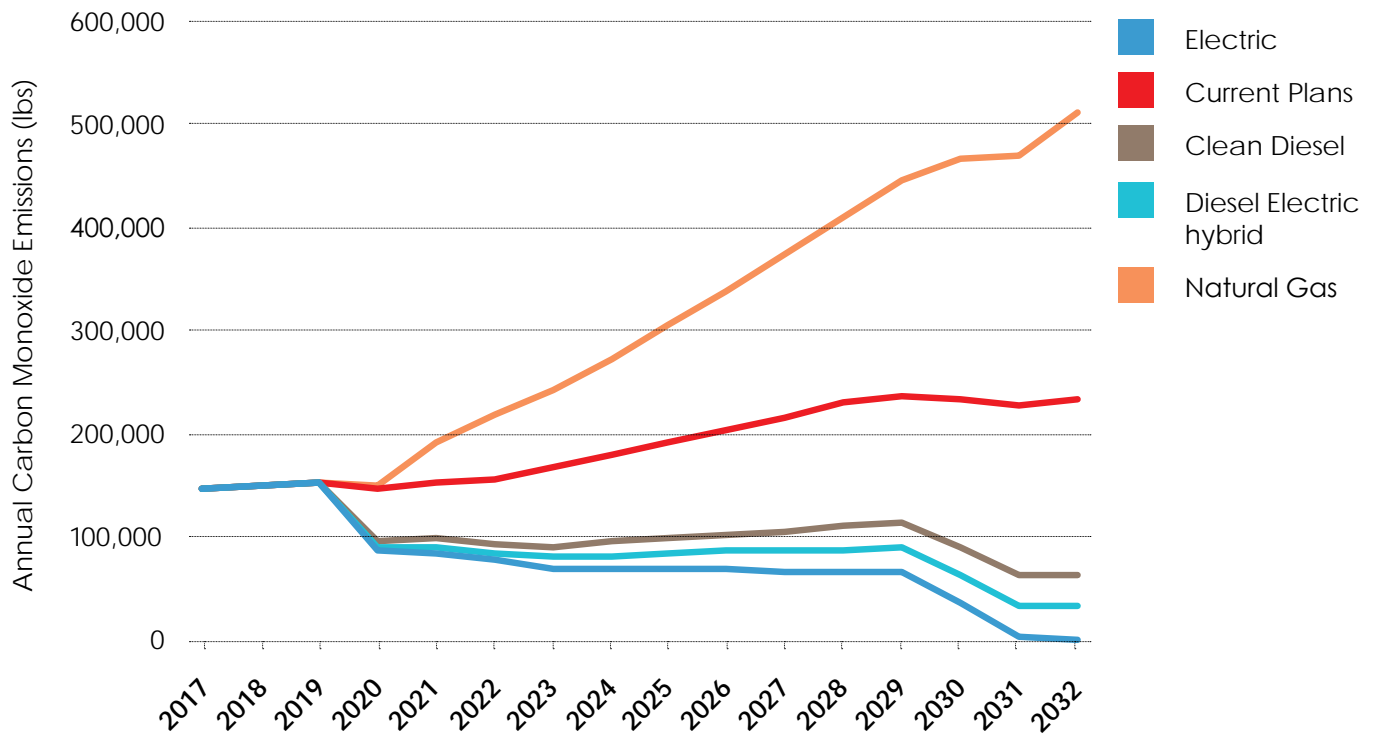
↑ **Table A8.** Summary of Transit Bus Fuel Switching Scenario Results



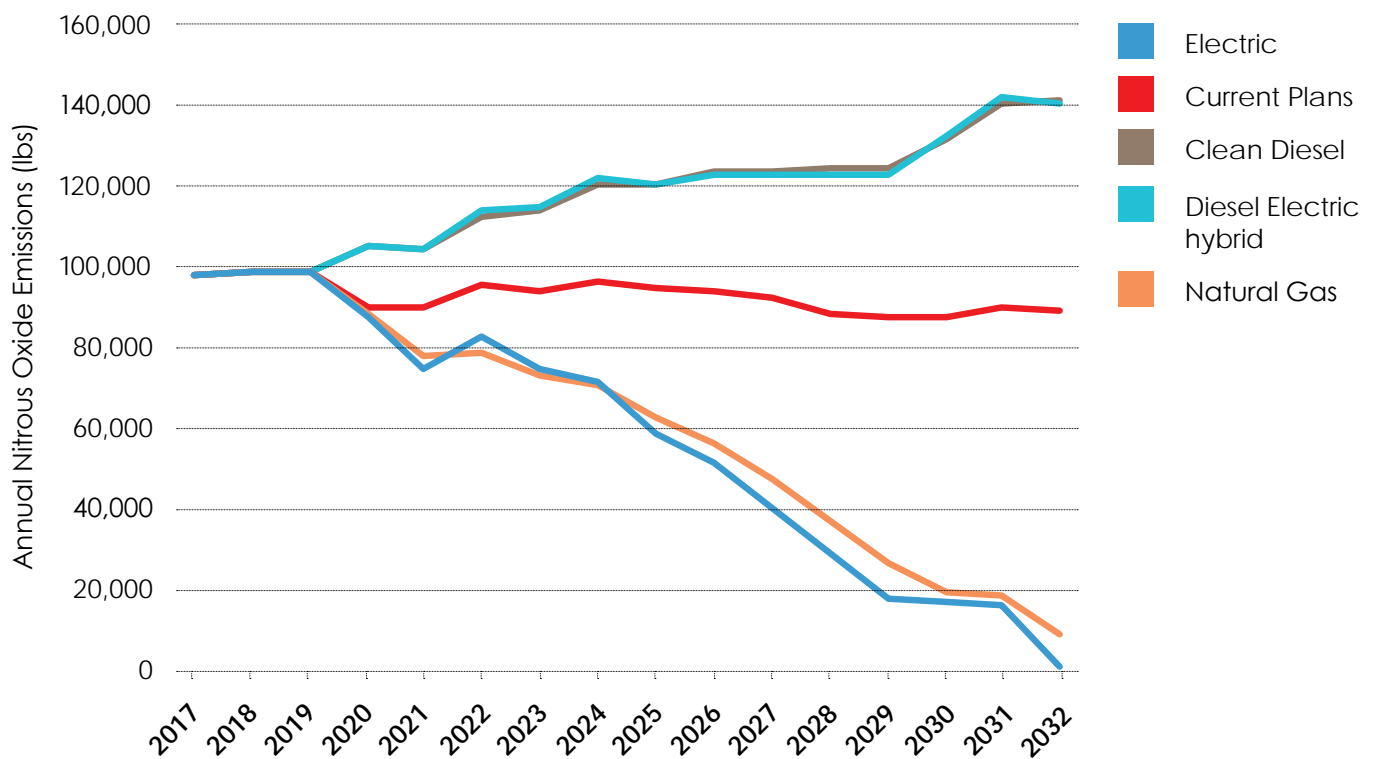
↑ **Figure A1.** Annual Energy Consumption Forecast, WMATA and DDOT Buses



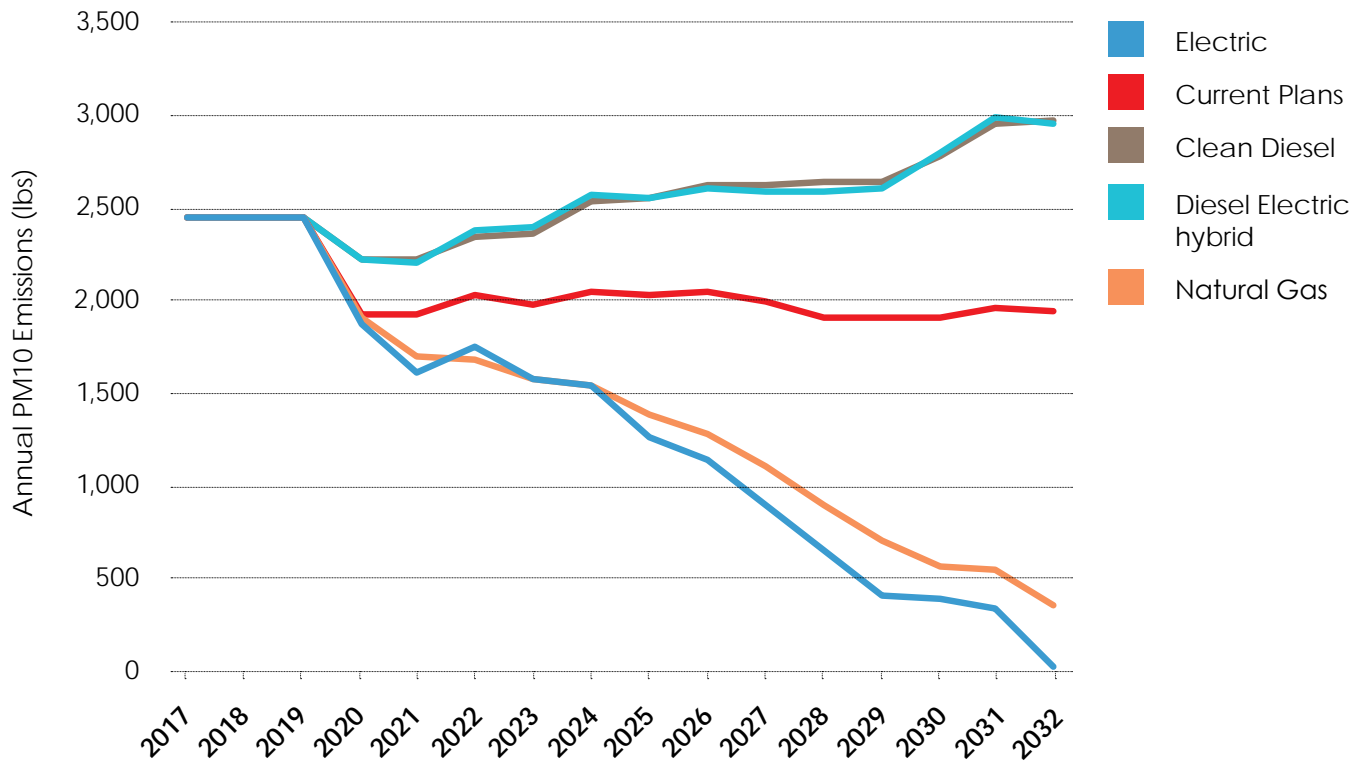
↑ **Figure A2.** Annual Greenhouse Gas Emissions Forecast, WMATA and DDOT Buses



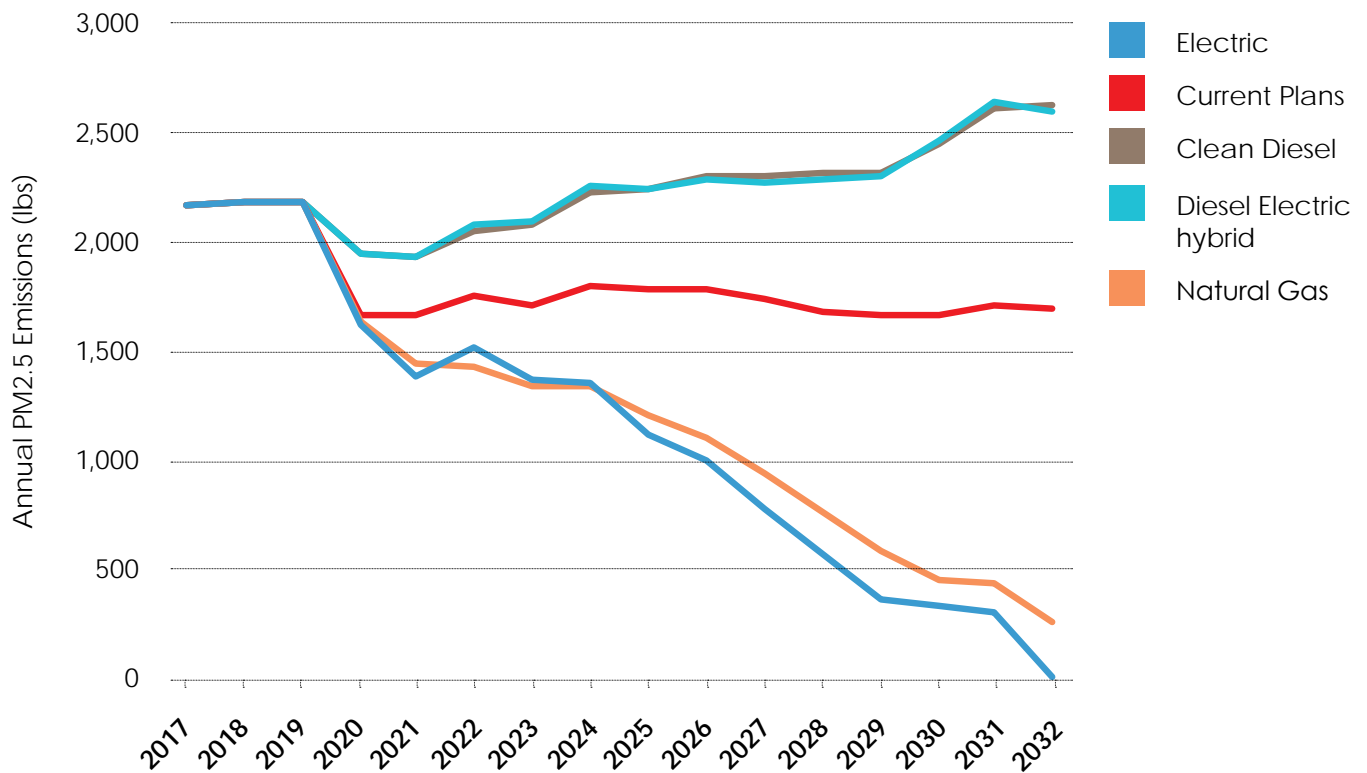
↑ **Figure A3.** Annual Carbon Monoxide Forecast, WMATA and DDOT Buses



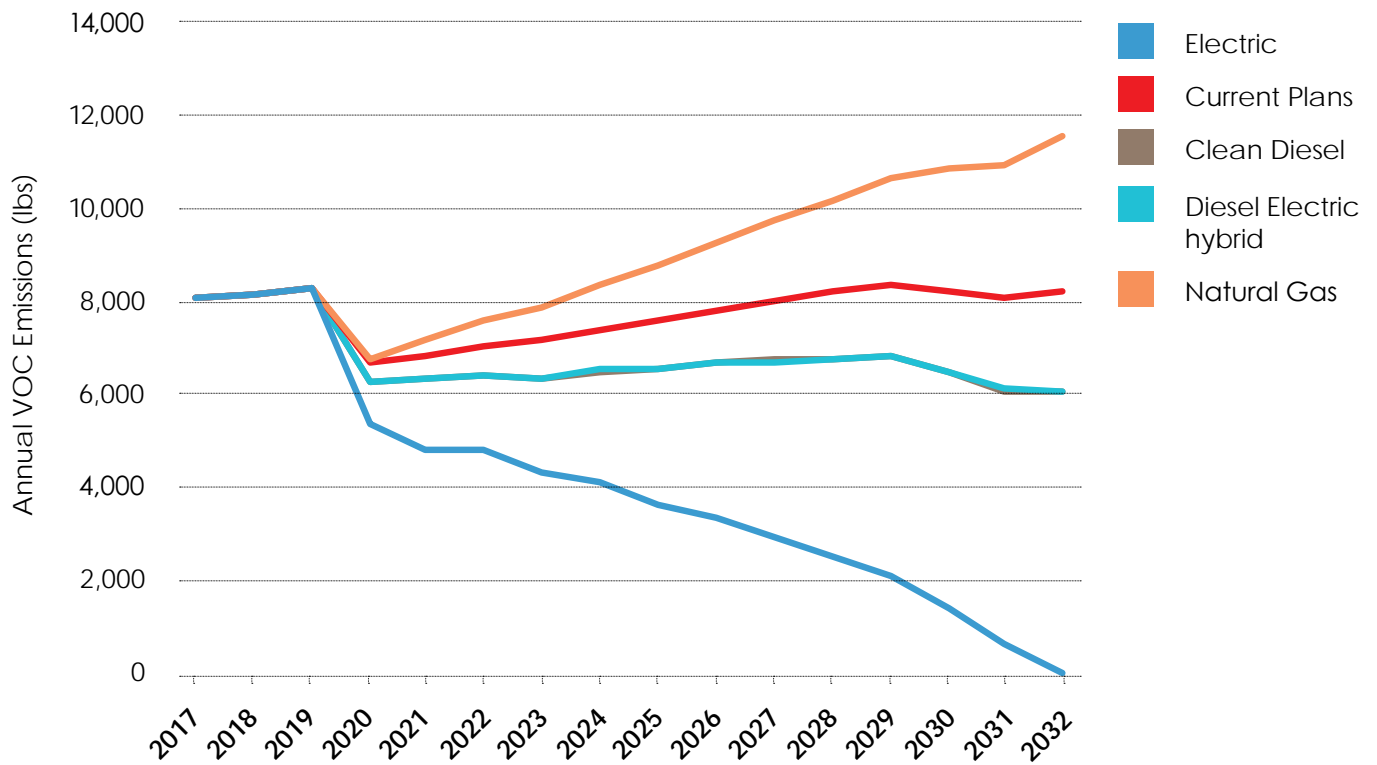
↑ **Figure A4.** Annual Nitrous Oxide Forecast, WMATA and DDOT Buses



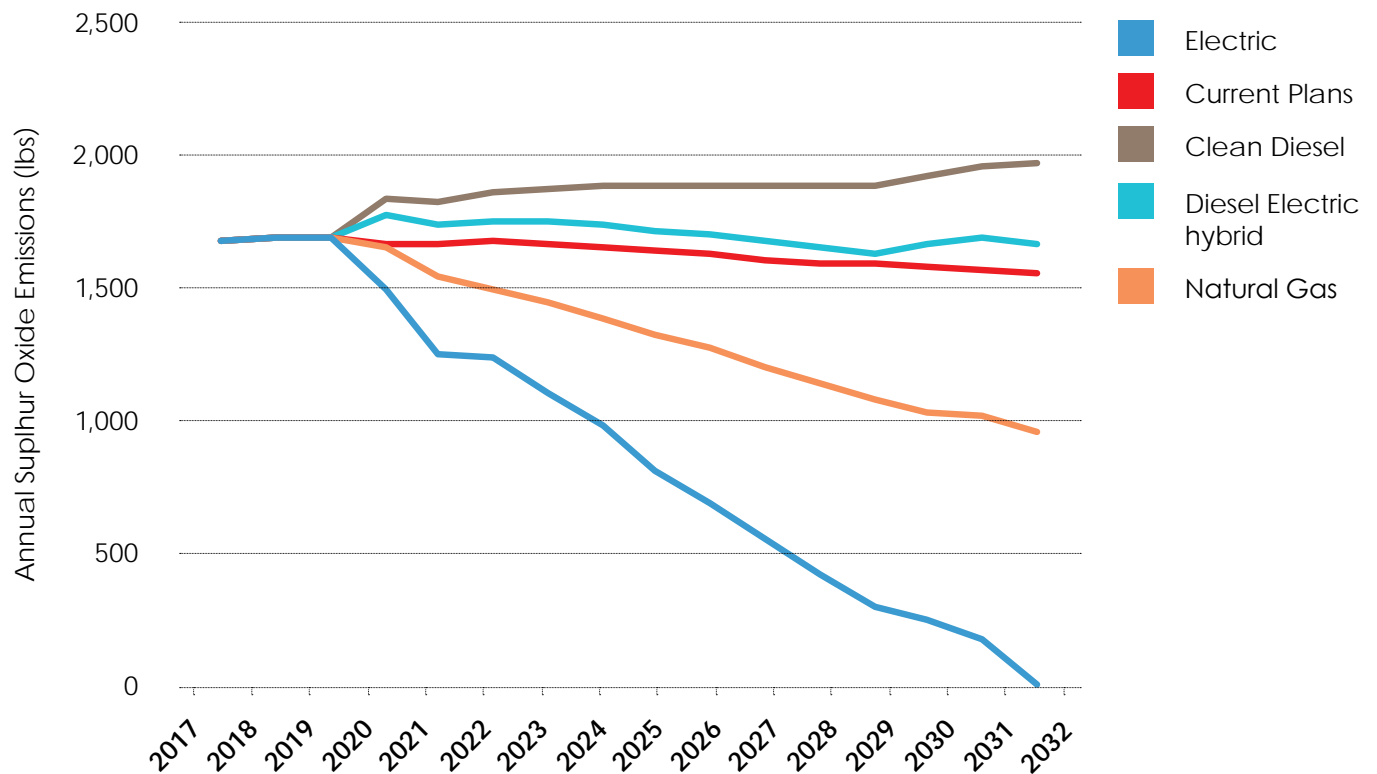
↑ **Figure A5.** Annual Particulate Matter 10 Micron Forecast, WMATA and DDOT Buses



↑ **Figure A6.** Annual Particulate Matter 2.5 Micron Forecast, WMATA and DDOT Buses



↑ **Figure A7.** Annual Volatile Organic Compounds Forecast, WMATA and DDOT Buses



↑ **Figure A8.** Annual Sulphur Oxides Forecast, WMATA and DDOT Buses

A1.2.3.4 FULL TRANSIT BUS EMISSIONS FORECAST RESULTS

The following assumptions apply to the transit emissions evaluation model used for the forecasting described in Appendix A1.2.3.3. These assumptions were dependent on data availability, project scope, and project timeline, among other factors.⁴⁶²

- The model base year is calendar year 2016 using 2015 fleet composition and mileage data in order to avoid distortions caused by major rail maintenance programs.
- Beginning with the large legacy diesel retirement in Year 2, operating miles per vehicle are held constant per fleet (WMATA, DDOT).
- Fuel economy varies within the model according to Phase 2 fuel economy standards for 2021-2027.^{463,464}
- Schedule of fleet additions and retirements are based on the following:
 - Transit agency future procurement forecasts^{465,466}
 - Standard WMATA transit fleet vehicle service life, assuming mid-life overhaul: 15 years
 - Standard DDOT transit fleet vehicle service life, assuming mid-life overhaul: 15 years^{467,468,469}
- Due to the time constraints of this project and difficulty in accurately characterizing criteria air pollutants from power generation plants outside the District, within those time constraints, criteria air pollutants are only quantified at the point of consumption – combustion in the transit vehicles.
- Per the scope of this project, the following criteria air pollutants are accounted for in the model: carbon monoxide (CO), nitrogen oxides (NOx), particulate matter (PM), volatile organic compounds (VOCs), and sulfur oxides (SOx).
- The “clean diesel” alternative is based on diesel propulsion buses manufactured or retrofitted to comply with 40 CFR 88.105-94, and the self-reporting of WMATA and DDOT identifying vehicles within their fleets as compliant.
- Legacy diesel vehicles are modeled using constant 2006 criteria pollutant emission factors found in the EPA’s MOVES2014a model.⁴⁷⁰
- The alternative fuel factor multiplier for carbon monoxide emissions of CNG transit buses was reduced from 44.34 to 1 to mirror that of passenger vehicles.
- Deterioration factors for CO and VOC emissions derived from the MOVES2014a model were changed to gradually increase over the 30 year period to reflect more likely behavior.

A1.2.4 OTHER EMISSIONS SOURCES

Although GHG emissions from waste are included in the model, waste was not within the scope of the Plan, so these emissions are not affected by policies. Rather, they are held static to reflect uncertainty in the interaction between growth in waste and the impact of District action to achieve its zero waste vision.⁴⁷¹

⁴⁶² Washington Metropolitan Area Transit Authority, “SafeTrack,” accessed November 20, 2017, <https://www.wmata.com/service/SafeTrack.cfm>

⁴⁶³ Center for Climate and Energy Solutions, “Federal Vehicle Standards,” accessed December 4, 2017, <https://www.c2es.org/content/regulating-transportation-sector-carbon-emissions/>

⁴⁶⁴ DieselNet, “United States: Heavy-Duty Vehicles: GHG Emissions & Fuel Economy,” accessed December 4, 2017, https://www.dieselnets.com/standards/us/fe_hd.php

⁴⁶⁵ Washington Metropolitan Area Transit Authority, “Customer Service, Operations and Security Committee, Action Item III-A, Adoption of Bus Fleet Plan,” September 14, 2017, <https://www.wmata.com/about/board/meetings/board-pdfs/upload/3A-Metrobus-Fleet-Plan-TO-POST.pdf>

⁴⁶⁶ District Department of Transportation, “DC Circulator 2017 Transit Development Plan Draft,” September 2017, <http://www.dccirculator.com/wp-content/uploads/2017/10/DC-Circulator-2017-TDP-Update-101818.pdf>

⁴⁶⁷ Sean Egan, phone call with project team, October 30, 2017.

⁴⁶⁸ Mid-life overhauls are scheduled to begin with model year 2014 vehicles. Source: District Department of Transportation, “DC Circulator 2017 Transit Development Plan Draft,” September 2017, <http://www.dccirculator.com/wp-content/uploads/2017/10/DC-Circulator-2017-TDP-Update-101818.pdf>

⁴⁶⁹ Sean Egan, phone call with project team, October 30, 2017.

⁴⁷⁰ U.S. Environmental Protection Agency, MOVES2014a Motor Vehicle Emission Simulator, <http://www.epa.gov/otaq/models/moves/index.htm>

⁴⁷¹ <https://zerowaste.dc.gov/>



PUBLIC REVIEW AND ENGAGEMENT REPORT

The District Government is committed to a vision of a sustainable city that benefits all—a commitment that extends to climate action. To achieve the GHG goals, the District Government will need to listen to and consider the perspectives, opinions, concerns, experiences of all those who live and work within its boundaries. Given the scale of action this Plan proposes, and its broad and long-term implications, engaging community members and key local stakeholders proved crucial. This appendix details the phases the plan went through during development, public comment, and revision. A separate appendix, published on the DOEE website, will detail each comment received, and how DOEE and the Clean Energy DC Team response.

A2.1 PLAN DEVELOPMENT HISTORY

A2.1.1 DEVELOPMENT OF THE INITIAL PLAN

The Clean Energy DC Plan is the District's latest Comprehensive Energy Plan (CEP). The District of Columbia Department of Energy and Environment (DOEE) is mandated to create and update a Comprehensive Energy Plan on regular intervals by the D.C. Energy Act of 1980 (D.C. Official Code § 8-171.04). Completing a brand-new Comprehensive Energy Plan was called for in the District's Sustainable DC Plan, in Energy Action 1.3. The Sustainable DC Transformation Order (Mayor's Order 2013-209) further mandated that the new Comprehensive Energy Plan lay out a pathway to achieve the District's goal of reducing Greenhouse Gas (GHG) emissions by 50% by 2032. Due to its focus on GHG emissions, and the fact that 97% of the District's GHG emissions come from the use of energy, it in many ways serves as the District's new climate mitigation plan. In the process of developing the current Plan, it was decided to brand it as "Clean Energy DC," to reflect the fact that it combines elements of a traditional state comprehensive energy plan and a typical municipal climate action plan.

The timeline of the development of the Clean Energy DC plan is laid out in Figure A9, and discussed below.



↑ **Figure A9.** *The Clean Energy DC Plan Development Process*

In May 2015, DOEE released a Request for Applications (RFA) for assistance in completing and communicating a Comprehensive Energy Plan for the District of Columbia (DOEE RFA #2015-1511-EA).⁴⁷² After a competitive selection process, DOEE selected Integral Group LLC as the lead grantee, with the Institute for Market Transformation (IMT) and the International Living Future Institute (ILFI) as partners. Nelson\Nygaard and LINK Strategic Partners were brought on as additional partners in 2017, to add additional expertise in the areas of transportation planning and public engagement, respectively.

Work began in August 2015, with a Visioning Workshop held in October 2015. Integral Group, IMT, and ILFI worked to compile the feedback from the visioning session, interviews with key experts both within DC and globally, and international best practices into a set of over 90 possible actions. These actions were plugged into a Community Energy Model (as described in Appendix A1) that was developed for the plan, which led to the production of the first draft of the plan. This plan and model were reviewed during two days of interactive workshops in March 2016. After substantial feedback from DOEE and other government stakeholders, more interviews, analysis, and modeling, a peer review draft was completed in August 2016.

A2.1.2 PEER REVIEW

In September 2016, DOEE distributed a “peer review” draft of the plan to key stakeholders and experts for a technical review. 143 attendees representing 74 distinct organizations were invited to the peer review. DOEE held six peer review discussion meetings, each 90 minutes long, with six distinct stakeholder groups. 79 people, representing 39 distinct organizations, attended one or more of these meetings and many provided comments, both orally and in writing. The list of participating organizations is provided in A2.1.5. The plan was again edited before its publishing at the end of October 2016. Over two-thirds of the peer review comments were fully addressed

⁴⁷² RFA for Completing and Communicating a Comprehensive Energy Plan, May 29, 2015, <https://doee.dc.gov/node/1070582>

in the published draft. Some comments could not be addressed at that time, as they required more time and resources to investigate; however, most have now been addressed in this final plan. A full list of the people and organizations who participated in the peer review is provided in the Peer Review Report published by DOEE; this report also contains DOEE's original responses to all peer review comments.⁴⁷³ All comments are also included in this appendix, though many have updated responses.

A2.1.3 PUBLIC ENGAGEMENT

At the end of October 2016, DOEE published a draft plan, along with a summary report, for broader public comment.

Between May and November 2017, DOEE and the LINK Strategic Partners organized and operated a city-wide outreach effort to engage community members on Clean Energy DC and related topics, to ensure that the Plan represented and supported as broad a range of voices and communities as possible. The team designed engagement opportunities to gather feedback on each of the Plan's key components, and refine its recommendations.

The Clean Energy DC team organized a series of grassroots engagement efforts that took place throughout the summer, including 20 total activations that ranged from canvassing at supermarkets and Metro Stations to tabling at community events like the Beat the Streets Festival and the H Street Festival. Grassroots canvassing was held in locations in all eight wards of the city. During these events, members of the Clean Energy DC team distributed several hundred flyers and conducted more than 300 short surveys to gauge attitudes and behaviors on climate and energy.

At the same time, DOEE conducted a statistically significant survey of over 800 District residents, focused on the Sustainable DC plan, but which contained several key energy-related questions to help the District understand the views of citizens regarding energy efficiency and renewable energy.

To complement grassroots outreach, the Clean Energy DC team hosted several community meetings presented as highly interactive forums meant to bring energy to life in an engaging way. The District-wide meetings were designed for a wide array of community members, ranging from highly engaged climate champions to individuals with no prior knowledge of the District's sustainability efforts. The first event, Energy-Palooza, was a family-friendly event with hands-on activities for attendees of all ages. Held at the Greater Washington Urban League Building in Columbia Heights, participants learned how wind turbines work, built their own solar matchbox cars, designed green homes with Lego bricks, and explored sustainable transportation alternatives. The second event, Clean Energy Power Hour, placed a traditional meeting format in a unique setting. Held at the Blue Jacket Brewery in Navy Yard, this event offered a brewery tour and tasting followed by an overview of Clean Energy DC and small group discussions. This was followed by Clean Energy Brown Bag, a more traditional public meeting held at DOEE's offices over lunchtime, featuring an overview of the plan followed by group discussion. In total, approximately 100 people participated in these three events.

⁴⁷³ Clean Energy DC Supplement: Peer Review Report," May 2017, https://doee.dc.gov/sites/default/files/dc/sites/ddoe/page_content/attachments/Clean%20Energy%20DC%20Supplement%20Comment%20Response%200517_0.pdf

Alongside the public engagement, DOEE hosted individualized meetings with each key stakeholder group. Specific meetings were held with environmental advocates, District Government departments, Pepco, Washington Gas, DC Water, the Office of People's Counsel, the Public Service Commission, the DC Sustainable Energy Utility, the Metropolitan Washington Council of Governments, the Sustainable Energy Utility Advisory Board, and the Green Building Advisory Council.

A2.1.4 ADDRESSING EQUITY

The Clean Energy DC team coordinated a series of interviews that focused on the intersection of energy, environment, and social equity. The team invited local and national experts, leaders, and organizations focused on local and national sustainability, social justice, policy advocacy, and community development issues to review and critique the draft Plan's recommended actions. Representatives from the following organizations and businesses participated in an interview:

- Anacostia Riverkeeper
- Children's Environmental Health Network
- Grid Alternatives
- Groundswell
- Nspiregreen
- Provoc
- Sierra Club DC
- University of the District of Columbia
-

Beyond this, the *Clean Energy DC* team consulted with local and national equity experts and advocates, to ensure its recommendations would not have unintended impacts on communities.

- Andrew Brooks, Association for Energy Affordability
- Charlie Harak, National Consumer Law Center
- Stephanie Chan, Greenlining Institute
- Lindsay Robbins, National Resources Defense Council
- Lori Bamberger, Mills College
- Wayne Waite, California Housing Partnership Corporation

Working with these local and national experts, the Clean Energy DC team collaboratively developed specific adjustments to the actions, which were included in the final plan. Chapter 3 provides further details on equity in *Clean Energy DC*, including how each action was adjusted to better address equity concerns.

A2.1.5 MAJOR UPDATES TO THE CLEAN ENERGY DC PLAN

The Clean Energy DC Team has made major updates to Clean Energy DC in response to public comments. Every comment received, with a response from DOEE, is provided in a separate supplement document, Appendix A3, published separately on DOEE's website. At a high level, these are the major changes to Clean Energy DC:

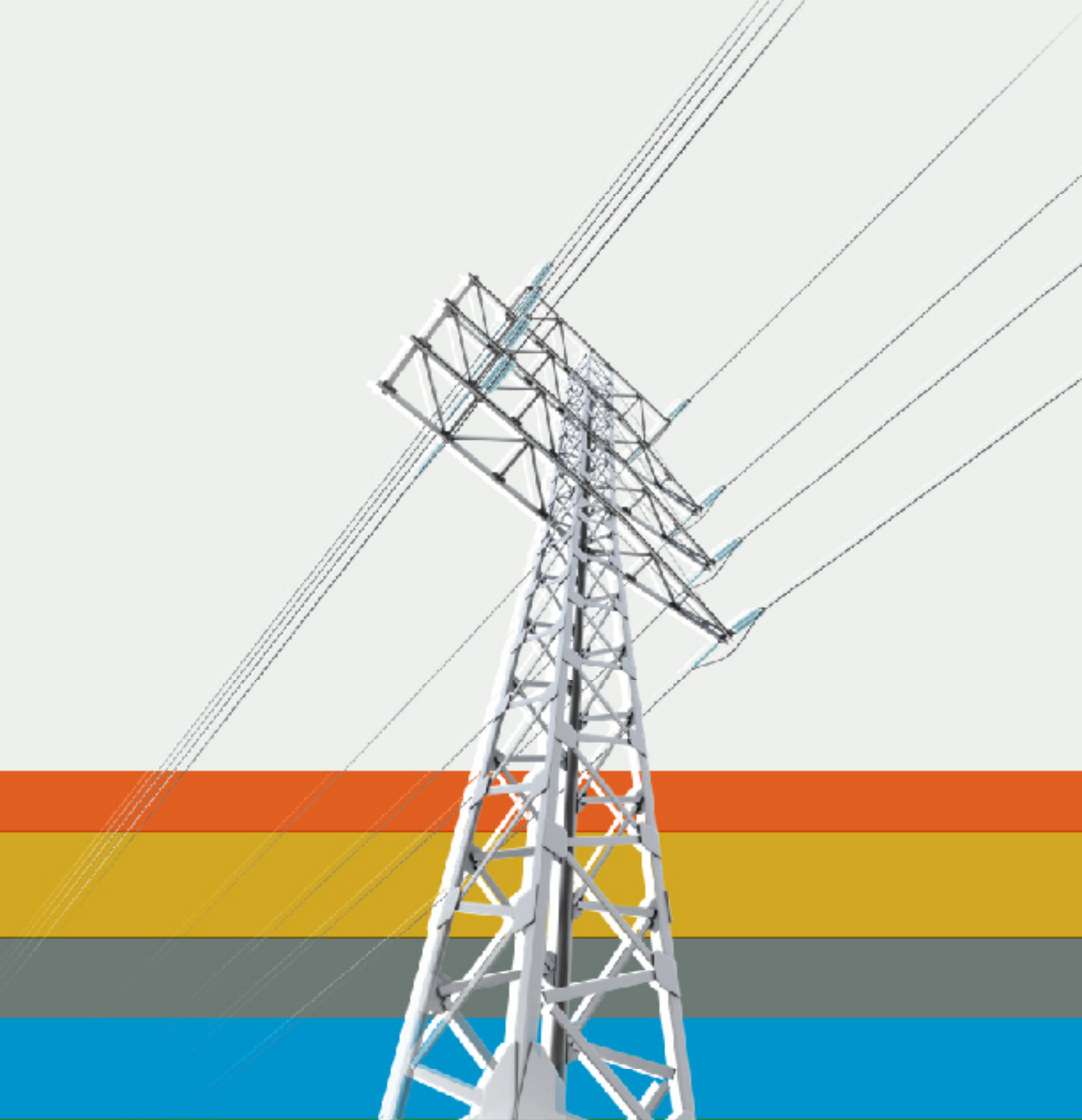
- Expanded introduction
- Improved community energy model
- More information about the sources of the District's electricity
- New chapter on equity
- New action on equity (EQ.1)
- Revisions to 20 other actions in the plan to address equity
- Updated actions on energy codes and incentives for net-zero energy buildings (NC.1 & NC.2)
- Expanded discussion and improved actions related to deep energy retrofits
- Updated action on Building Energy Performance Standards (EB.5)
- New action on energy planning for District Government facilities (EB.10)
- Reorganized and consolidated section on Cross-Cutting Building Actions, with three new actions that consolidate multiple actions from the draft plan (CCB.6, CCB.11, CCB.12)
- Updated actions related to the Sustainable Energy Utility (EB.2, CCB.1)
- Updated action on the Standard Offer Service (CRE.2)
- Updated actions related to local solar power (CRE.4, CRE.5, & CRE.6)
- Transit vehicle emissions modeling
- Background and two new actions on zero-emission transit vehicles (EV.7 & EV.8)
- Background and three new actions on anticipating autonomous ride-hailing vehicles (EV.9, EV.10, & EV.11)

A2.2 PARTICIPATING GROUPS

The following organizations participated actively in the development and revision of Clean Energy DC. DOEE appreciates each of them for their assistance and looks forward to continuing to partner with them as this plan is implemented. (Peer reviewers are marked with a * icon.)

- Amalgamated Bank*
- Anacostia Riverkeeper
- Association for Energy Affordability
- Capital E
- Children's Environmental Health Network
- ClearPath
- ClearRock
- Coalition for Green Capital
- DC Climate Action*
- DC Office of Planning (OP)*
- DC Sustainable Energy Utility (DCSEU)*
- DC Water*
- DC Public Schools (DCPS)*

- Department of Consumer & Regulatory Affairs (DCRA)*
- Department of General Services (DGS)*
- Department of Housing and Community Development (DHCD)*
- District Department of Transportation (DDOT)*
- Downtown DC Business Improvement District*
- Green Building Advisory Council (GBAC)*
- GRID 2.0*
- GRID Alternatives
- Greenlining Institute
- Groundswell*
- Hannon Armstrong Capital
- Housing Partnership Corporation
- Ipsun Power
- Johnson Controls
- Metropolitan Washington Council of Governments*
- National Consumer Law Center
- National Resources Defense Council
- Nspiregreen
- Office of People's Counsel (OPC)*
- Oracle
- Pepco*
- Provoc
- Public Service Commission (PSC)*
- Sierra Club DC*
- Sparkfund
- Sustainable Community Initiatives
- Sustainable Energy Utility Advisory Board
- Solar United Neighborhoods of D.C. (D.C. SUN)*
- The George Washington University*
- U.S. Green Building Council (USGBC)*
- University of the District of Columbia (UDC)
- Urban Ingenuity*
- Washington Gas*
- Wentworth Green Strategies*
- WGL*



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